ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts have been prepared only of material that is believed to be generally available.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey. Washington, D.C. 20242. Serial publications cited for the first time are as follows:

Annales Inst. Geol. Publici Hungarici—Annales Instituti Geologici Publici Hungarici. Muszaki Konyvkiado, Budapest, Hungary.

Internat. Assoc. Math. Geology Jour.—Journal of the International Association for Mathematical Geology. Plenum Pub. Corp. New York, N. Y.

Jour. West—Journal of the West. Lorrin L. Morrison and Carroll Spear Morrison, Publishers. Los Angeles, Calif.

U.S. Dept. Interior Off. Library Services Bibliog. Ser.—United States Department of Interior Office of Library Services Bibliographic Series. Washington, D. C.

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ABSTRACTS

01814 **Abbott, Walter; Dawson, C. E.** Physical, chemical, and biological characteristics of estuaries — Section on bacteria by C. H. Oppenheimer, Chap 2 *in* Water and water pollution handbook, V. 1 (Leonard L. Ciaccio, editor): New York, Marcel Dekker, Inc., p. 51-140, illus., tables, 1971.

Estuaries, occasionally formed as a result of land subsidence and maritime flooding, were usually created by inundation of river valleys when sea level rose during post-glacial thaws. Various geomorphological features of estuaries and factors affecting sedimentation are discussed. The circulation and mixing of sea and fresh water in estuaries depends on the coriolis force, tidal and river flow, and wind action. Chemical and biological composition of estuary water and various types of pollution are covered. — EH

02000 **Acree, E. H.; Brashear, H. R.; Case, F. N.** An underwater survey system for radionuclide-tagged sediment tracing, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 815-820, illus., table [1971].

Survey equipment for use in tracing sediment tagged with radionuclides has been designed and field tested. The system is unique in its ability to operate on the dry beach, in the surf, and in deep water, making it possible to examine synoptically to beach face, surf zone, and off-shore marine environment. The ball-shaped radiation detector vehicle is towed behind an amphibious vessel. Data are collected on punched tape at a rate of one set of data (position, radiation counts, time) every two seconds. Gold-198 and xenon-133 have been used for tagging sand indigenous to the survey area under study. Operational characteristics and detection sensitivity are discussed. — Authors' abstract

Acree, E. H. *See* Brashear, H. R. 02001

01407 **Addicott, Warren O.; Plafker, George.** Paleocene mollusks from the Gulf of Alaska Tertiary Province — A significant new occurrence on the North Pacific Rim, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B48-B52, illus., 1971.

Marine mollusks of Paleocene age occur near the base of a sequence of continental and marine strata mapped as the Kulthieth Formation in the foothills of the St. Elias Mountains, southern Alaska. The gastropod *Turritella merriami brevitabulata* Merriam and Turner indicates correlation with the upper Paleocene "Meganos Stage" of the Pacific coast of the conterminous United States. The fossils from the Malaspina district (lat 60° N.) provide evidence of the oldest marine strata thus far recorded from the Gulf of Alaska Tertiary province, and also record the first occurrence of marine Paleocene from north of California (lat 40° N.). Accordingly, Paleocene seas were not of restricted distribution but in fact extended over broad areas along the North Pacific rim. — *from* Authors' abstract

Ade-Hall, James. *See* Watkins, Norman D. 01470

02062 **Agarwal, R. G.; Kanasewich, E. R.** Automatic trend analysis and interpretation of potential field data: Geophysics, v. 36, no. 2, p. 339-348, illus., 1971.

In this investigation, the fast Fourier transform is applied to the analysis of two-dimensional data. In particular, a cross correlation function has been used to obtain

trend directions of magnetic data. The technique is applicable to other geological or geophysical data. An empirical method has been devised to trace the trends by fitting a least squares third degree polynomial to the maximum coefficient in the correlation matrix. An example from Stony Rapids, northern Saskatchewan illustrates the method. — Authors' abstract

01708 **Akella, Jagannadham; Kennedy, George C.** Studies on anorthite + diopside$_{50}$-hedenbergite$_{50}$ at high pressures and temperatures: Am. Jour. Sci., v. 270, no. 2, p. 155-165, illus., tables, 1971.

The reaction between anorthite + diopside$_{50}$-hedenbergite$_{50}$ to garnet + quartz was investigated from 1000 to 1500°C and between 10 and 40 kb. At lower pressures the stable assemblage is pyroxene + anorthite. This reacts at higher pressures to form garnet + pyroxene + anorthite + quartz. At the highest pressure, garnet + quartz + pyroxene are the stable phases. The boundaries corresponding to the appearance of garnet and disappearance of anorthite were determined. Equilibrium was approached from both the high pressure direction and the low pressure by the use of crystalline materials. The slope of the boundary where garnet appears is 15 bars/°C. Anorthite disappears along a boundary with a slope of 19 bars/°C. Garnets show a steady increase in the amount of calcium as the pressure is increased. This is because of the continuing breakdown of anorthite as pressure is increased. — Authors' abstract

Aki, Keiiti. *See* Tsai, Yi-Ben. 01882

01715 **Alexander, Charles S.; Prior, Jean Cutler.** Holocene sedimentation rates in overbank deposits in the Black Bottom of the lower Ohio River, southern Illinois: Am. Jour. Sci., v. 270, no. 2, p. 361-372, illus., tables, 1971.

Radiocarbon dates of organic matter in the flood plain indicate three rates of sedimentation in the recent past, ordered with regard to increasing intensity, they are: ridge deposition, swale fill, and natural levee deposition. Swale and ridge deposition occurred at an increasing rate during the last 4000 to 8000 years. All rates reflect varied environments of deposition. Periods of river bank erosion interspersed with deposition could account for long-term dynamic stability in the river margin indicated by the radiocarbon dates. The slowly increasing rate of deposition may be related to gradual decline in flow of excess Ohio River flood waters through the Cache Valley beginning about 8000 years ago, and to vegetation disturbance by upriver cultivation during the last 1500 years. — *from* Authors' abstract

01484 **Alexander, E. C., Jr.; Lewis, R. S.; Reynolds, J. H.; Michel, M. C.** Plutonium-244 — Confirmation as an extinct radioactivity: Science, v. 172, no. 3985, p. 837-840, illus., tables, 1971.

The mass spectrum of xenon from spontaneous fission in a laboratory sample of plutonium-244 is precisely what meteoriticists predicted it would be; this discovery completes a web of proof that this nuclide is a bona fide extinct radioactivity of galactic origin, that r-process nucleosynthesis was ongoing in the galaxy at the time of the birth of the Sun, and that the early meteoritic abundances of plutonium-244, heretofore tentative, can be utilized with confidence in models for the chronology of galactic nucleosynthesis. The search for an explanation for anomalous fission-like xenon in carbonaceous chondrites can now be narrowed. — Authors' abstract

Alexander, E. C., Jr. *See* Srinivasan, B. 01772

Alford, D. *See* Andrews, J. T. 01621

Ames, H. T. *See* Traverse, A. 01516

01693 **Anders, D. E.; Robinson, W. E.** Cycloalkane constituents of the bitumen from Green River shale: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 661-678, illus., tables, 1971.

Fifty-two cyclic alkanes isolated from the Green River shale were analyzed by mass spectrometry. The molecular formula of each was determined and where possible, structural assignments were proposed. Structurally there is a resemblance to the hydrocarbon framework of biologically derived isoprenoid lipids. Twenty-one probably had their origin in carotenoid pigments; 6 possibly in the indane portion of vitamin D formed from irradiation of steroidal plant debris, 8 probably were derived from plant steroids, and 15 could have been derived from pentacyclic triterpenoids. — DBV

02055 **Anders, Edward.** How well do we know "Cosmic" abundances?: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 516-522, illus., 1971.

Five lines of evidence suggest that Cl chondrites closely approximate the condensable fraction of primordial solar-system matter: continuity of isotopic and elemental abundance trends, agreement with solar and cosmic-ray abundances, fractionation patterns among chondrites, and absence of chondrules. Maximum differences between Cl abundances and true solar-system abundances are estimated as factors of 2-5 for individual elements and a factor of 1.5 or less for groups of 10 or more elements. — Author's abstract

Anders, Edward. *See* Herzog, G. F. 02058

01468 **Anderson, A. T.; Gottfried, David.** Contrasting behavior of P, Ti, and Nb in a differentiated high-alumina olivine tholeiite and a calc-alkaline andesitic suite: Geol. Soc. America Bull., v. 82, no. 7, p. 1929-1941, illus., table, 1971.

Crystallization differentiation in a low-K_2O, high-Al_2O_3 olivine tholeiite (Hat Creek, Calif.) yields segregation veins of basaltic andesite composition, and residual, interstitial glasses of dacite and rhyolite composition. P, Ti, and probably Nb, are progressively enriched in segregation veins and residual dacitic glass by crystallization of olivine, plagioclase, augite and magnetite. P and Ti are depleted in residual rhyolitic glass by crystallization of magnetite, ilmenite, and apatite. By contrast, in a typical orogenic calc-alkaline suite (from Mount Jefferson, Ore.), P, Ti, and Nb are depleted with increasing K and Si. The most likely minerals capable of producing decreasing P, Ti, and Nb with increasing K are apatite, Fe-Ti oxides, amphibole, biotite, and sphene. There is no direct evidence of these minerals in Mount Jefferson basalt and andesite, but they are present in calc-alkaline gabbro and tonalite and may occur at a shallow (crustal) depth beneath Mount Jefferson. — *from* Authors' abstract

02020 **Anderson, E. J.** Environmental models for Paleozoic communities: Lethaia, v. 4, no. 3, p. 287-302, illus., 1971.

Nearshore communities in Paleozoic epeiric seas occur in two distinct lateral patterns which parallel shorelines — an expanded pattern of five and a compressed pattern of three laterally adjacent communities. The two community patterns are correlated with two distinct environmental models which are a product of local tectonics. Model 1 (tectonically stable) develops in lc ⁄ slope transgressing epeiric seas. Model 2 (tectonically active) develops in high slope prograding epeiric seas commonly with abundant terrigenous clastic influx. Environmental variables and organic evolution change community constituents, but the broad community patterns recur at least through the early and middle Paleozoic. — Author's abstract

Anderson, G. M. *See* Nriagu, J. O. 01577

01438 **Anderson, John J.** Geology of the southwestern High Plateaus of Utah — Bear Valley Formation, an Oligocene-Miocene volcanic arenite: Geol. Soc. America Bull., v. 82, no. 5, p. 1179-1205, illus., tables, geol. map, 1971.

Following the build-up of an early and middle Tertiary volcanic pile on the High Plateaus, volcanic arenite and associated clastic sediments accumulated in and around the Markagunt Plateau to form the Bear Valley Formation. The formation is "a moderately well-sorted, fine- to medium-grained, zeolite cemented submature to

mature volcanic arenite" that covers more than 1,000 miles to a maximum depth of 1,000 feet. Glass shards in the sand and beds of ignimbrite and tuff attest to minor and local volcanism during the time of accumulation, late Oligocene and Miocene. — RGY

01869 **Andrews, J. R.; Emeleus, C. H.** Preliminary account of kimberlite intrusions from the Frederikshaab district, South-West Greenland: Grönlands Geol. Undersögelse Rap. 31, 26 p., illus., tables, 1971.

Kimberlite intrusions from three localities, Nigerdlikasik, Pyramidefjeld and Midternaes, show closely comparable petrographical, mineralogical and geochemical features. They contain ultramafic garnet, spinel and phlogopite peridotite inclusions which appear to have been derived from the Upper Mantle, though scapolite granulite nodules in the Nigerdlikasik kimberlite must have originated in the lower crust. Garnet and spinel peridotite were sampled at successively higher levels by the kimberlite magma and micaceous peridotites were produced by phlogopitization of some of these inclusions during transport. Generation of the kimberlites took place during the early Mesozoic and forms part of the Mesozoic pattern of igneous activity in South-West Greenland. — Authors' abstract

01621 **Andrews, J. T.; Fahey, Barry D.; Alford, D.** Note on correlation coefficients derived from cumulative distributions with reference to glaciological studies [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 145-147, table, 1971.

In many areas of glaciology, cumulative degree days, either positive or negative, are regressed against another cumulative value, such as ablation or lake-ice growth. Very strong functional relationships are frequently found with high correlation coefficients. This note shows that, if pairs of random numbers are cumulated, the resulting correlation coefficients are extremely high with a Fisher transformed mean of $r = 0.986$ and standard error of ± 0.001 (based on 50 individual computations of r which in turn were based on 20 cumulated pairs of random numbers between 0 and 99). These results indicate that caution must be exercised in the physical interpretation of data of this kind. — Authors' abstract

Angino, Ernest A. *See* Bowles, Frederick A. 01532

01929 **Annells, R. N.** Middle Keweenawan volcanism of eastern Lake Superior [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 7-8, 1971.

Anthony, E. H. *See* Vilks, G. 08755

01997 **Arem, Joel E.** The state of the art — X-ray crystallography — [Pt.] 1, The basics: Mineralog. Rec., v. 2, no. 2, p. 57-68, illus., 1971.

Experiments in 1912 showed that X-rays were a short-wave form of energy, and crystals were proved to be made of atoms. Four types of bonds holding atoms together are: metallic, van der Waals, covalent, and ionic. Crystal growth in mono- and polycomponent crystallization, the formation of lattices and relation to crystal systems are discussed. The role of point symmetry involves rotations, reflections, and inversions, while lattice symmetry involves displacements through space. Formation of a crystal by symmetry is described. The total symmetry combinations possible in crystals are 230, and every crystalline substance is atomically arranged in accord with the symmetry of one of these 230 space groups. Each lattice type shows the full symmetry possible for the crystal system it belongs to. Describing crystal faces in terms of the units at which the face crosses the coordinate axes, and the way symmetry operations act on atoms within the crystal are discussed. — ESL

01405 **Armstrong, A. K.; Mamet, B. L.; Dutro, J. Thomas, Jr.** Lisburne Group, Cape Lewis-Nink Creek, northwestern Alaska, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B23-B34, illus., 1971.

Sections of Lisburne Group, Mississippian, were measured in structurally complex terrane on rootless allochthonous thrust sheets. Exposures at Cape Lewis consist of 1,284 feet of Visean shales and carbonates of the Nasorak Formation and 1,864 feet of "Namurian" carbonates of the Kogruk Formation. An incomplete 215-foot-thick section of the Nasorak Formation at Niak Creek is uppermost Meramec, lowermost Chester equivalent. On an underlying thrust sheet at Niak Creek, an incomplete section of the Kogruk Formation is 715 feet thick and is a Meramec age equivalent. Within these sections six foraminiferal assemblage zones are recognized and tied to Cordilleran and Eurasian standards. A fauna of 14 taxa of lithostrotionoid corals is also present in Meramec and earliest Chester age beds. — *from* Authors' abstract

01713 **Armstrong, Richard Lee; Stump, Edmund.** Additional K-Ar dates, White Mountain magma series, New England: Am. Jour. Sci., v. 270, no. 2, p. 331-333, table, 1971.

Dates of 96.4 and 100 m.y. for the Cuttingsville complex and 111 m.y. for the Barber Hill stock in Vermont, 169 m.y. for a camptonite dike near Wallingford, Conn., and 197 and 199 m.y. for the Red Hill stock, N.H., demonstrate the long time span during which White Mountain magma series plutons were emplaced. The oldest plutons of this magma series cluster in central New Hampshire and southern Maine. Other related stocks show a consistent decrease in age with increasing distance from the initial cluster in central New Hampshire, a time-transgressive pattern that must have genetic and tectonic significance. — Authors' abstract

Arnold, Allan R. *See* Walton, Brian J. 08768

08715 **Aronovici, V. S.; Schneider, Ariand D.; Jones, Ordie, R.** Basin recharging the Ogallala aquifer through Pleistocene sediments, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 182-192, illus., 1970.

Two 0.1-acre recharge basins were excavated into the Pleistocene pluvial sediments underlying the Pullman soil on the Southwestern Great Plains Research Center. Simulated playa water containing suspended solids was applied to Basin A for 66 days with a total intake of 14.9 acre feet. Percolation rates rose until 0.92 pounds of sediment per square foot of basin was added. Basin C was filled with sediment-free water for 46 days with a total percolation of 20.0 acre feet. A maximum percolation rate of 7.0 feet per day was reached. The reaction of the water table in the Ogallala aquifer underlying both basins and the rapid drop in the perched water table after the water was turned off showed conclusively that percolate was passing through to the water table. Suspended solids and zooplankton reduced percolation rates in Basin A. — DBV

02025 **Arpin, Oscar E.** Tidal inlet problems along the New England coast, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1171-1185, illus. [1971].

The New England Division of the U.S. Army Corps of Engineers has created and improved many harbors along the New England coast. A harbor, to be effective, must provide a protected area for boats and must have a safe access, that is, a protected and stabilized tidal inlet. The major engineering problems encountered in the development of harbors involve stabilization of these inlets. The problems are caused by excessive littoral drift resulting from erosion of the shorefront adjacent to the inlets by wave attack. Planning, designing, constructing, and modifying these inlets under very dynamic conditions is complex and difficult. Each inlet is unique. This paper discusses some of the problems encountered. — *from* Author's abstract

01511 **Ashlock, Peter D.** Monophyly and associated terms: Systematic Zoology, v. 20, no. 1, p. 63-69, illus., 1971.

Most definitions of the term monophyly are ambiguous because they do not limit the common ancestor sufficiently. Henning's (1966) definition, which requires that a monophyletic group contain all the descendants of the common ancestor, is precise, but it is narrower than the classic concept of monophyly and is here renamed

holophyly. A precise definition of monophyly may be formulated if the common ancestor need be only cladistically a member of the group — that is, if a group can be shown to have one or more unique evolutionary innovations, it may be inferred that the most recent common ancestor also had these innovations. The ancestor need not have reached the grade of, or phenetically be, a member of the group. Paraphyly (Henning, 1966) is the other aspect of monophyly, which applies to groups that have a common ancestor, but in contrast to holophyly, do not include all the descendants of that ancestor (for example, Reptilia). — *from* Author's abstract

01549 **Asquith, Donald.** The Earth is like an onion?: Jour. Geol. Education, v. 19, no. 3, p. 149-152, illus., 1971.

Recent slope deposition in basins is discussed and diagrammed. This process in ancient sediments is well known to petroleum geologists from interpreting well logs. However, examples of slope deposits in older sediments have not been sufficiently documented. Greater emphasis should be placed on the study of slope deposition as an integral part of sedimentation in the past. — EH

Atchison, M. E. *See* Muller, J. E. 01922

Attaway, David H. *See* Calder, John A. 01982

Austin, T. Al. *See* Claborn, B. J. 08710

Avé Lallemant, H. G. *See* Raleigh, C. B. 01876

02023 **Ave'Lallement, Hans; Carter, Neville L.** Pressure dependence of quartz deformation lamellae orientations: Am. Jour. Sci., v. 270, no. 3, p. 218-235, illus., table, 1971.

In tests on Canyon Creek quartzite for pressure dependence of quartz deformation lamellae orientations, four distinct orientations are recognized: basal — high pressure, low temperature; prismatic — high temperature, low pressure; subbasal I — moderate temperature, low pressure; and subbasal II — high temperature, high pressure. A fifth field in which lamellae form at all orientations overlaps the prismatic-subbasal I-II fields. Subbasal I lamellae are identical in optical properties and orientation to most deformation lamellae in quartz-bearing tectonites. Results suggest that at strain rates lower than about 10^{-13}/sec, subbasal I lamellae should form at all crustal pressures to about 500°C. Presence of water does not appear to affect P-T fields of the various mechanisms. Subbasal lamellae may form only in crystals lacking a basal plane of symmetry. — *from* Authors' abstract

Avignone, Nicholas F. *See* Swift, Donald J. P. 01672

01933 **Awald, John T.** Regional geochemical reconnaissance of the Bradshaw Mountains, Arizona: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 114-119, illus., 1971.

The Bradshaw Mountains of west-central Arizona cover an area of 1600 square miles and contain numerous old mines and prospects. The area has been geochemically sampled on a reconnaissance basis to relate mineralized areas to regional structure and rock types. Copper analyses of stream sediments have been classified and contoured to show the distribution of low and high backgrounds and low, intermediate, and highly anomalous areas. Contoured results are compared to geology and known mines. Several prospecting areas are indicated. — Author's abstract

01581 **Baca Uruñuela, Manuel.** Introducción a la gravimetría (la Parte) [Introduction to gravimetry, Pt. 1]: Asoc. Mexicana Geofísicos Explor. Bol., v. 12, no. 1, p. 1-63, illus., table, 1971.

This article summarizes basic theories of gravity and various methods of measuring it. — EH

01576 **Bachechi, F.** Crystal structure of montbrayite: Nature Phys. Sci., v. 231, no. 20, p. 67-68, illus., table, 1971.

The crystal structure of montbrayite, a rare mineral of idealized formula Au_2Te_3, is postulated on the basis of its similarities to the gold-silver ditellurides calaverite, krennerite, and sylvanite. The X-ray study was carried out on a sample from the type locality, Robb-Montbray, Quebec. The crystallographic data are: space group P_1, a = 12.11A, b = 13.44A, c = 10.80A, $\alpha = 104°23'$, $\beta = 97°30'$, $\gamma = 107°56'$, V = 1577.4, Z = 12. The atomic parameters are listed, and a projection of the structure on a plane normal to [001] is given. — DBV

01890 **Bacon, Forrest.** California's Geologic Atlas complete: California Geology, v. 24, no. 6, p. 99-103, illus., 1971.

The history behind the 28-sheet Geologic Atlas of California, released in May 1971, is reviewed. It is the fourth map of the entire state published by what is now called the Division of Mines and Geology. The first was published in 1891, at a scale of 1:750,000, and emphasized economic aspects. The second map, issued in 1916, and accompanying a bulletin, had the same scale as the first, and listed 21 geologic units. In 1938 a third map was published, at a scale of 1:500,000, and required six separate sheets to show the state; the legend showed 81 units, and for the first time, faults were shown as well as rock units. The legend on the new map has 124 units, and distribution of structural features is indicated. The Division is now preparing a multi-purpose geologic map for housing and development planning studies; Quaternary faults and volcanic phenomena will be shown. — ESL

01999 **Bahjat, Dhari S.; Duda, Seweryn J.** Instrumentation and procedure for three-dimensional model experiments: Jour. Physics Earth, v. 19, no. 1, p. 21-30, illus., table, 1971.

Three-dimensional model experiments broaden in principle the class of solvable problems [in seismology], if compared with two-dimensional experiments. In particular, the determination of the energy balance during wave generation by a small explosion inside the medium becomes possible. The corresponding experiments require a well-calibrated instrumentation. The procedure of the experiment and the calibration of an apparatus involving displacement-type transducers is described. The calibration is based on a generalization of the shake table concept to the frequency range of interest in model experiments. — Authors' abstract

Bailey, H. H. *See* Barnhisel, R. I. 01561

Bailey, N. J. L. *See* Rogers, M. A. 02061

01451 **Baird, A. K.; Baird, K. W.; Morton, D. M.** On deciding whether trend surfaces of progressively higher order are meaningful — Discussion [of paper by F. Chayes, 1970]: Geol. Soc. America Bull., v. 82, no. 5, p. 1219-1233, illus., tables, 1971.

This paper disagrees with the previous conclusions of Chayes (ibid., v. 81, no. 4, p. 1273-1278, 1970; Abs. North American Geology, October 1970) concerning trend surfaces. The results from sampling the Lakeview Mountains pluton, Calif. (Morton and others, 1969), are defended. In the present discussion it is concluded that the meaning of a trend surface can be considered as follows: whether it curves sufficiently to accommodate the model, whether the data have differences on local scales, and whether the surface is substantiated by independently derived data. — AG

Baird, K. W. *See* Baird, A. K. 01451

01944 **Bajorunas, L.** Littoral transport and energy relationships, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 787-798, illus., tables [1971].

The littoral transport rates in the Great Lakes were obtained two distinctly different ways; long-term averages from drift accumulations and hourly averages were measured in the St. Clair River which receives sand from Lake Huron beaches. Statistical analysis of both the recorded energy elements and measured sediment transport rates indicates that a combination of energy elements and environmental factors consisting of wave power and duration, current speed, and length of shoreline produces the best

correlation with the transport rate. Dimensional analysis expands the process-response model by including sediment-size and specific-weight parameters. — Author's abstract

01951 **Bakker, W. T.; Klein Breteler, E. H. J.; Roos, A.** The dynamics of a coast with agroyne system, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1001-1020, illus. [1971].

This paper is a continuation of one by the first author in which a mathematical theory of the behavior of a coast after construction of a groyne system was given. It extends the former paper theoretically and practically: (1) Theoretically a computer program was made which takes into account the influence of diffraction behind the groyne. (2) Practically, the coastal constants in the theoretical model of the coast are expressed in terms of wave height and direction. Results are given of computations with a coastal model in which the coast is schematized to one line (one-line theory) and a model in which the coast is schematized to a beach line and an inshore-line (two-line theory). The influence of changing wave conditions is investigated. — *from* Authors' abstract

Bakst, Ajoy K. *See* Watkins, Norman D. 01470

Baldwin, Alton L. *See* Bubeck, Robert C. 01487

01799 **Banks, P. O.; VanSchmus, W. R.** Chronology of Precambrian rocks of Iron and Dickinson Counties, Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 9-10, 1971.

01722 **Barlai, Zoltán.** Some principal questions of well-logging evaluation of hydrocarbon-bearing sandstones with a high silt and clay content — Experience acquired by the field application of a new method: Log Analyst, v. 12, no. 3, p. 7-30, illus., table, 1971.

This paper concerns a new well-logging evaluation method developed in Hungary for the evaluation of hydrocarbon-bearing sandstones with high silt and clay content. Principal questions relating to the determination of water saturation, hydrocarbon saturation, grain-size distribution, porosity and permeability of reservoir rocks of normal composition are investigated. Problems and possible answers concerning the determination of the electrical resistivity of fully water-saturated reservoir rocks are discussed. The process for determination of constant quantities used in the evaluation functions is also outlined. For a selected geological structure results obtained from practical application of the method in ten boreholes are presented and are compared with results obtained by other methods. Outlines for the computer application of this method are presented. — *from* Author's abstract

Barnes, Ivan. *See* O'Neil, James R. 01692

01784 **Barnes, Ivan; O'Neil, James R.** Calcium-magnesium carbonate solid solutions from Holocene conglomerate cements and travertines in the Coast Range of California: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 699-718, illus., tables, 1971.

A study of Ca-Mg carbonate minerals in fresh water conglomerates and travertines from the Coast Range of California has shown that calcite solid solutions extend over the compositional range from $CaCO_3$ to $Ca_{0.5}Mg_{0.5}CO_3$ and that they lack the [006] X-ray diffraction maximum over most of the compositional range and lack the [015] ordering diffraction maximum over the entire range. Dolomite is a solid solution throughout part of the range and yields both [016] and [015] maximums over its whole compositional range. Both solid solutions apparently are direct precipitates rather than exchange reaction products. Unless stable isotopic compositions indicate an entirely locally derived unaltered homogenized meteoric origin for the Ca-Mg carbonates, C-14 ages cannot be unequivocally interpreted. — DBV

01746 **Barnes, Lawrence G.** *Imagotaria* (Mammalia: Otariidae) from the late Miocene Santa Margarite Formation near Santa Cruz, California: PaleoBios, no. 11, 10 p., illus., table, 1971.

Fossil jaws and skull fragments of one individual, found near Olympia, Santa Cruz County, Calif., are referable to the extinct otariid pinniped genus *Imagotaria*; the specimen adds information to the anatomy of the genus and extends its known geographic range 200 miles northward from the type locality of the genotype, *I. downsi* Mitchell, 1968, in Santa Barbara County. Because of differences in dentition, the new specimen cannot be referred confidently to *I. downsi*; identified herein only as *Imagotaria* sp., it may represent a more primitive form. — *from* Author's abstract

01561 **Barnhisel, R. I.; Bailey, H. H.; Matondang, Sahat.** Loess distribution in central and eastern Kentucky: Soil Sci. Soc. America Proc., v. 35, no. 3, p. 483-487, illus., tables, 1971.

It was determined that the loess mantle of Kentucky extends about 148 km (92 miles) from the Ohio River as determined by a 341-km (212-mile) transect study from Jefferson Co. to Pike Co. Beyond 148 km (92 miles), the loess was either absent or too thin to be recognized. The initial portion of the transect 0-84 km (0-52 miles) indicated that the loess was of two ages associated with the glaciation periods. These conclusions were based largely on the percent silt in the sample, expressed on a clay-free basis, although titanium and feldspar analyses were conducted. — Soil Brief

Bartlett, Alexandra. *See* Langenheim, Jean H. 02049

02013 **Bartlett, Charles S., Jr.; Webb, Harry W.** Geology of the Bristol and Wallace quadrangles, Virginia: Virginia Div. Mineral Resources Rept. Inv. 25, 93 p., illus., tables, geol. map, 1971.

The Bristol and Wallace quadrangles, in Washington County in southwestern Virginia within the Valley and Ridge physiographic province, are underlain by bedrock ranging in age from Lower Cambrian through Upper Mississippian and including Ordovician, Silurian, and Devonian rocks. Outcropping rocks are assigned to 30 formations, 27 sufficiently thick, well exposed and lithologically different to be separately mapped. One of the most complete sections of Mississippian rocks in North America is exposed. Quaternary alluvium and terrace deposits were also mapped. Major structural features are parts of the Greendale and Beaver Creek synclines and the Saltville, Pulaski-Staunton, Spurgeon, and Bristol fault blocks. Formational outcrop belts and major fault traces are mostly aligned NE-SW and have southeasterly dip. The Bristol fault has an arcuate trace. The largest displacement is along the Saltville fault trace. Crushed limestone is produced in the Bristol quadrangle. — *from* Authors' abstract

Basham, P. W. *See* Liebermann, Robert C. 01753

Bassiouni, Zaki A. F. *See* Gabillard, Robert L. A. 02036

Bates, Robert L. *See* Sweet, Walter C. 01545

01769 **Baughman, Wilbur T.; McCutcheon, Thomas E.; Bicker, Alvin R., Jr.; Dinkins, Theo H., Jr.; Shows, Thad N.** Rankin County geology and mineral resources: Mississippi Geol. Econ. and Topog. Survey Bull. 115, 226 p., illus., tables, geol. maps, 1971.

The report on the geology and mineral resources of Rankin County in central Mississippi consists of five sections, written by the individual authors and cited separately in this volume. The sections cover the geology of the county, clay tests, mineral industries, subsurface strata and water resources. The county lies in the Gulf Coastal Plain physiographic province. Bedrock exposed at the surface ranges in age from Eocene to Recent. The major structural feature is the Jackson Dome. Clay, limestone and marl, sand and gravel are quarried and cement production is a major industry. Oil and gas, recently discovered, contribute about 50 percent of the total value of

mineral production. Large quantities of fresh surface and groundwater of good quality supply municipal, industrial and domestic needs. Pollution is present in the Pearl River below Jackson and in some smaller streams. — EH

01979 **Bauleke, Maynard P.** Incipient expansion in Kansas volcanic ash: Kansas Geol. Survey Bull. 202, pt. 1, p. 9, illus., 1971.

Expansion in a volcanic ash shard starts wherever the temperature-viscosity conditions are optimum for expansion. — Author's abstract

01980 **Bauleke, Maynard P.** Differential thermal analysis (DTA) study of Kansas montmorillonitic clays from Phillips and Wallace Counties: Kansas Geol. Survey Bull. 202, pt. 1, p. 11-13, tables, 1971.

Differential thermal analysis (DTA) curves of Kansas montmorillonites will most likely be those of "abnormal" montmorillonite. No sample showed the single dehydroxylation reaction peak at 725°C of a normal montmorillonite. The predominant dehydroxylation reaction occurred at 525°C, although, especially in samples from Phillips County, two dehydroxylation peaks at 525° and 675°C were often present in a sample. Most curves had the typical two-peak endothermic water loss reactions in the 100-200°C range associated with calcium montmorillonite. Caliche (calcium carbonate) was a common impurity in Wallace County materials. All were very low in organic matter; based on fired color, Wallace County material has a higher content than material from Phillips County. — Author's abstract

01881 **Baxter, Murdoch; Funkhouser, John.** Rare gases in the Lost City and Suchy Dul meteorites: Jour. Geophys. Research, v. 76, no. 17, p. 4056-4060, tables, 1971.

Stable rare-gas concentrations in the bronzite chondrites Lost City and Suchy Dul have been determined. The exposure and potassium-argon ages of Lost City (8 m.y. and 4.1 b.y.) are consistent with the age groupings of H5 chondrites, whereas the Suchy Dul ages (23 m.y. and 1.9 b.y.) appear more typical of hypersthene chondrites. Both meteorites contain small amounts of primordial rare gases. Suchy Dul, however, cannot be classified as gas rich despite its light-dark structure. — Authors' abstract

01688 **Bé, Allan W. H.; vanDonk, Jan.** Oxygen-18 isotopes of recent planktonic foraminifera [discussion of paper by A. D. Hecht and S. M. Savin, 1970]: Science, v. 173, no. 3992, p. 167-169, illus., 1971.

For the paper under discussion, *see* ibid., v. 170, no. 3953, p. 69-71, 1970; Abs. North American Geology, April 1971.

Bé, Allan W. H. *See* Hunkins, Kenneth. 02005

01761 **Belyayeva, N. V.** Quantitative distribution of planktonic Foraminifera in Atlantic Ocean sediments: Oceanology, v. 10, no. 6, p. 820-830, illus., tables, 1970 [1971].

Low concentrations of planktonic Foraminifera are found on the continental shelves of all latitudinal zones and on the upper part of the continental slope at high latitudes. This distribution is related to the low concentrations of these organisms in the water above the shelves and to terrigenous dilution. Their abundance increases with depth. Maximum concentrations occur on underwater ridges and swells and on the ocean floor at depths not exceeding "critical" ones. "Critical" depth ranges from 3,500 to 4,000 m at high and from 4,500 to 5,000 m at low latitudes. No planktonic Foraminifera have been found on the bottom of deep-sea basins at depths of more than 4,000 m in the boreal and notalian regions or at depths of more than 5,000 m in the Tropics. — Author's abstract

01967 **Bender, Michael L.** Does upward diffusion supply the excess manganese in pelagic sediments?: Jour. Geophys. Research, v. 76, no. 18, p. 4212-4215, illus., table, 1971.

Simple calculations indicate that upward diffusion of Mn^{++} through pelagic sediment pore water can supply manganese at the rate it has been observed to accumulate in pelagic sediments (about 1 mg per sq cm per thousand yr) only if manganese needs to be transported less than a meter or so in the sediment column. Data for manganese concentrations of sediment versus depth in the core indicate that the average thickness of the manganese-rich zone of pelagic sediments is at least 10 meters; therefore upward diffusion does not supply a large portion of the 'excess' manganese in most manganese-rich pelagic sediments. — Author's abstract

Benson, Richard H. *See* Sylvester-Bradley, Peter C. 02021

Bentall, Ray. *See* Keech, C. F. 01613

08760 **Berdan, Jean M.; Martinsson, Anders.** Ostracodes — American ostracode zonation; Correlation with Europe, *in* Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, p. 39-44, 1970.

Formal ostracode zones have been proposed only for the interval C_3 through Wenlock in the Silurian of North America. Ostracodes have not as yet been adequately described from pre-C_3 age beds of the Mississippi Valley region; little is known of their Silurian faunal succession in the Arctic, and even less of those in the area west of the Rocky Mountains. A considerable amount of descriptive work must be done before any comprehensive zonation is possible; where ostracode zones have been established, they have proved to be of considerable use in correlation. Large ostracodes represented by "Kloedenia" are apparently part of an indigenous Appalachian fauna which extends from Virginia to western Maine. A parallel belt east of this, between Nova Scotia and Massachusetts, is occupied by ostracode associations with strong North European affinities; their faunal correlation is discussed here by Martinsson. — GDC

02024 **Berg, Eduard; Pulpan, Hans.** Tilts associated with small and medium size earthquakes: Jour. Physics Earth, v. 19, no. 1, p. 59-78, illus., tables, 1971.

Tilt observations from nearby local earthquakes of M = 3-5 and larger teleseisms show an amplitude reduction with epicentral distance R of A (in seconds of arc) = $10^{M-4.1} \times R^{-1}$. The result is compared to static elastic dislocation models. Velocities of tilt propagation range from 2.1 to 2.8 kmps for near earthquakes, and up to 3.3 kmps for teleseisms. From discrepancies between strain and tilt observations and static elastic dislocation theory, tilt reduction with distance, and propagation velocities, the strain and tilt steps are viewed as a surface type propagation phenomenon. Earthquake-associated tilts and first motions imply a S-SE to N-NW compression along the northern edge of Tanana Basin [Alaska]. Earthquake locations and depths indicate active faults south of Fairbanks along the northern edge of a gravity low, along the Chatanika River, and on the northern extension of Minto fault. — *from* Authors' abstract

Berg, Robert R. *See* Davies, David K. 01855

01863 **Bergendahl, M. H.** Expanded need for mineral economics in exploration for metals: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 801-803, 1971.

Geologists are becoming more frequently involved with mineral economics in the exploration for metals. The involvement is mainly concerned with (1) competition, (2) broadening commodity interests, and (3) mining costs. The geologist must maintain communications with all subdivisions of his company and have educational facilities available to function effectively. — HWR

08721 **Berrangé, Jevan P.** The geology of two small layered hornblende peridotite (picrite) plutons in South Greenland: Medd. Grönland, v. 192, no. 1, 43 p., illus., tables, 1970; Grönlands Geol. Undersögelse Bull. 92, 1970.

Two ultramafic dikes [near Sarqa fjord], intruded during the 2d Ketilidian plutonism, pinch and swell like some kimberlite bodies. Contact metamorphism of adjacent

granite was slight — albite-epidote hornfels facies. From petrologic, mineralogic and chemical evidence, a picritic parent magma underwent flowage differentiation due to rapid intrusion, then magmatic differentiation with gravity settling. The internal picritic layered group crystallized first, into hornblende peridotites, hornblende-hypersthene peridotites and rare harzburgite; the border group later, into hypersthene-olivine hornblendites, chemically picrites, and mica hornblendites, chemically monzanite, with minor hornblende gabbro. Steep banding cuts the earlier rhythmic layering, by diffusion of material into cooling cracks. Locally concentrated are sulfide and platinoid minerals. — *from* Author's abstract

Berry, L. G. *See* Radcliffe, Dennis. 01905

01471 **Berry, W. B. N.; Jaeger, H.; Murphy, M. A.** Position of *Monograptus uniformis* Pribyl in stratigraphic sequences in central Nevada: Geol. Soc. America Bull., v. 82, no. 7, p. 1969-1971, illus., 1971.

The Silurian-Devonian boundary has been the subject of relatively intense debate among stratigraphers for the last decade. As a result of field excursions to Nevada, a consensus has now developed that the Silurian-Devonian boundary should be drawn at the base of the *Monograptus uniformis* graptolite zone. — *from* Authors' introduction

08748 **Berry, W. B. N.; Boucot, A. J.** (editors, with contributions by Jean M. Berdan, Gilbert Klapper, Anders Martinsson, Carl B. Rexroad, Richard P. Sheldon, and Alfred M. Ziegler). Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, 289 p., illus., tables, geol. map, 1970.

Lithofacies and paleontologic aspects of the Silurian strata in North America have been analyzed; an alphabetical list of rock units is given. Silurian faunas, cosmopolitian over the Northern Hemisphere, permit use of the British shelly fossil series and Llandovery Stages and graptolitic Llandovery-Ludlow Zones for correlation of the Appalachian region. Brachiopod lineages and time-stratigraphic units were useful in constructing a correlation chart of the Silurian rocks of North America. Dolomites cover the continental interior, rimming limestones grade outward into belts of fine-grained then coarse terrigenous material. In concluding that marine waters covered the interior much of Silurian time, possible marginal sources for terrigenous debris are inferred. The vast expanse of carbonates suggests later repeated geosynclinal deposition and orogenic activity. — GDC

Berry, W. B. N. *See* Klapper, Gilbert. 08749

01686 **Bertine, K. K.; Goldberg, Edward D.** Fossil fuel combustion and the major sedimentary cycle: Science, v. 173, no. 3993, p. 233-235, table, 1971.

The combustion of the fossil fuels coal, oil, and lignite potentially can mobilize many elements into the atmosphere at rates, in general, less than but comparable to their rates of flow through natural waters during the weathering cycle. Since the principal sites of fossil fuel combustion are in the mid-latitudes of the Northern Hemisphere, changes in the composition of natural waters and air, as a consequence of this activity, will be most evident at these latitudes. — Authors' abstract

Bicker, Alvin R., Jr. *See* Baughman, Wilbur T. 01769

Billings, Gale K. *See* Hitchon, Brian. 02076

01566 **Bird, John M.; Dewey, John F.; Kidd, W. S. F.** Proto-Atlantic oceanic crust and mantle — Appalachian/Caledonian ophiolites: Nature Phys. Sci., v. 231, no. 19, p. 28-31, illus., 1971.

Details of the history of the Proto-Atlantic Ocean are elucidated from a study of the occurrence of ophiolite suites in the Appalachian-Caledonian system. — DBV

01631 **Birkeland, Peter W.; Crandell, Dwight R.; Richmond, Gerald M.** Status of correlation of Quaternary stratigraphic units in the western coterminous United States: Quaternary Research, v. 1, no. 2, p. 208-227, illus., 1971.

Quaternary deposits in the western United States represent a great variety of environments. An attempt is made to correlate representative sequences of deposits of many of these environments, using stratigraphic sequence, soil characteristics, amount of subsequent erosion, and interlayered volcanic ash beds of identifiable source. Chronological control is based on numerous radiocarbon dates, U-series dates on marine fossils, and K-Ar dates on volcanic rocks. The Bishop volcanic ash bed and one of the Pearlette-like ash beds are regional key horizons, above 700,000 and 600,000 yr old respectively. Rock magnetism and assigned ages of included land mammal fossils also held define some units. — DBV

Biscaye, Pierre E. *See* Dasch, E. Julius. 01542

01856 **Bishop, William F.** Geology of the upper member of Buckner Formation, Haynesville field area, Claiborne Parish, Louisiana: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 4, p. 566-580, illus., table, 1971.

Arkansas-Louisiana shelf-slope fields produce from calcarenites of the upper members of the Late Jurassic Smackover Formation and the overlying Buckner. Haynesville, the largest field, produced mainly from an up-dip porous reservoir facies of an east-west calcarenite bank in the Buckner Formation, here designated the 'A_3' producing zone. Hydrocarbon accumulation is stratigraphically controlled. The idealized updip to downdip section through a typical Buckner cycle includes evaporitic mudstone, nonporous shaly, transitional limestone, the reservoir, a low-porosity mixed facies, and pellet-muds. Nearly all of the 83 wells in the Haynesville field have been abandoned. Full economic potential was never realized, primarily because of failure to provide pressure maintenance programs for the solution gas reservoirs. — BHK

01534 **Bistráin, Pablo.** Causas de las fallas y asentamiento de suelos en los grandes embalsas [Causes of faults and settling of the earth in large basins (with Portuguese, French, English abs.)]: Ingeniería Hidrául. México, v. 25, no. 1, p. 51-70, illus., tables, 1971.

When water storage basins are filled settling of the earth occurs. The magnitude of settling depends on the characteristics of the basin and is more evident when faults are present. Some faults which have been inactive sometimes cause local tremors when water enters them, acting as a lubricant and facilitating displacement of the earth. The influence of hydrostatic pressure is appreciable. It is necessary to make geological studies of dam areas in order to ascertain the amount of settling, possible movements and quakes, and faults. The main factor in dam-failure is filtration, therefore its causes must be found. The fact that about 40 percent of Mexico is highly quake-prone must be taken into account. Experience of other countries in constructing dams in seismic areas must be considered. — *from* Author's abstract

Blackmon, Paul D. *See* Dyni, John R. 01425

01744 **Block, Barry; Dratler, Jay, Jr.** Teleseismic detection with wide band vertical and horizontal accelerometers: Nature Phys. Sci., v. 232, no. 28, p. 33-37, illus., table, 1971.

This is a preliminary report on the observation of teleseisms with both the vertical accelerometer and a new wide-band horizontal accelerometer at a surface site. The new instrument is similar in design to the vertical accelerometer, which has been described in detail already (Block and Moore, 1970). Although the new horizontal accelerometer is noisy at the observation site, the noise can be removed by digital filtering. The records then become a powerful adjunct to the vertical records for purposes of seismic detection. Both the theoretical power of Love waves as a source discriminant and an augmented signal-to-noise ratio for events producing Love waves are now available. — DBV

02090 **Bloom, Arthur L.** Glacial-eustatic and isostatic controls of sea level since the last glaciation, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 355-379, illus., tables, 1971.

The melting of ice sheets between 18,000 and 6500 yr B.P. provides a theoretically sound and demonstrably adequate cause for a corresponding glacial-eustatic rise of sea level of about 130 m. The thickness of former ice sheets can only be estimated; the present thickness suggests that they might have been several kilometers thick. On a graph of postglacial rise of sea level, compiled by Emery, the curve of rising sea level coincides with the curve of decreasing ice sheet area. For the last 8000-9000 years coasts have been submerging at a decelerating rate. An additional source for meltwater for a glacial-eustatic rise of sea level of about 3-5 meters must be sought. — *from* Author's summary

01603 **Bloss, F. Donald.** Crystallography and crystal chemistry, an introduction: New York, Chicago, Holt, Rinehart and Winston, 545 p., illus., tables, 1971.

This text for the beginning undergraduate in crystallography and crystal chemistry is of common interest to mineralogists, ceramists, chemists, solid-state physicists, and metallurgists. It has 13 chapters as follows: external symmetry; crystal classes, axes, and systems; crystal nomenclature and calculations; crystal projections; crystal forms and class determination; translational symmetry — lattices; internal symmetry — space groups; crystal chemistry; principles of crystal structures; structural variations, composition, and stability; physical properties; crystals and light; and introductory X-ray crystallography. — VSN

01497 **Boberg, Walter W.; Runnels, Donald D.** Reconnaissance study of uranium in the South Platte River, Colorado: Econ. Geology, v. 66, no. 3, p. 435-450, illus., tables, 1971.

Concentration of uranium in water of the South Platte River in Colorado during the winter of 1969-70 ranged from 5 ppb to 67 ppb, making it anomalously rich in uranium; concentration of uranium increases downstream. Most uranium in the South Platte probably is contributed by uraniferous coal seams in the Cretaceous Laramie Formation and by uranium-rich black shales in the Cretaceous Pierre Formation. Undiscovered deposits of uranium ore in its drainage basin cannot be excluded. Use of the parameter 'incremental areal uranium-load' permits certain portions of the basin to be recognized as contributors of anomalously large amounts of uranium. In the headwaters, incremental areal uranium-load is low, whereas for increment of drainage between Weldona and Balzac, it is 0.016 kg U/day/km^2. This parameter may be useful for hydrogeochemical prospecting for uranium ore in other areas. — *from* Authors' abstract

08765 **Bodenlos, Alfred J.** Cap-rock development and salt-stock movement, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 73-86, illus., table, 1970.

As Gulf Coast salt stocks slowly dissolve by ground water moving downdip in the geosyncline, residual anhydrite sands form dense cap rock, with sulfur only where reasonably thick. With 3 to 10 percent anhydrite in stocks, a cap rock of given thickness may represent a wide range of salt dissolved; most of these cap rocks derive from salt several thousand feet to several miles thick. In upper surfaces of stocks, at relatively uniform elevations, rising of salt fluctuated with its rate of solution; lenticular caps indicate greatest movement in cores of stocks. Movement was intermittent, but considerable while salt dissolved without deforming overlying strata. As groundwater circulation is restricted by impermeable anhydrite, rising salt develops stresses great enough to rupture cap rock. Diapirs form after burial of parent stock to depths where its density is less than that of overlying strata. — GDC

01706 **Bodvarsson, Gunnar.** Approximation methods for equivalent strata: Jour. Geophys. Research, v. 76, no. 17, p. 3932-3939, 1971.

Formal solutions are given for the integral equations governing the mass or unidirectional magnetic dipole densities on equivalent strata. The densities are given in terms of infinite series in the derivatives of the potential fields observed on planes parallel to the strata. In the magnetic case, the formal solution applies to dipoles with moments normal to the strata. A truncation of the series leads to an approximation method that is applicable to the long-wave components of the densities. An iterative approximation method given for the case of oblique field intensities and moments is applicable when the field and source vectors deviate little from the vertical. — Author's abstract

01879 **Bogard, D. D.; Clark, R. S.; Keith, J. E.; Reynolds, M. A.** Noble gases and radionuclides in Lost City and other recently fallen meteorites: Jour. Geophys. Research, v. 76, no. 17, p. 4076-4083, tables, 1971.

Radionuclides and noble-gas isotopic abundances have been determined in two recently fallen meteorites, Lost City and Murchison; noble-gas isotopic abundances in two additional meteorites, Ucera and Allende, have also been determined. Gas-retention ages for Lost City, Murchison, and Ucera all show evidence of gas loss. The U, Th-^{4}He, and K-Ar ages for Ucera appear to be concordant at 0.8 b.y. Cosmic-ray-exposure ages for Lost City, Murchison, and Allende are 5.5, 1.0, and approximately 5 m.y., respectively. The various exposure ages calculated for Ucera range from 5 to 21 m.y. and imply anomalous production ratios for these spallation-produced isotopes. — Authors' abstract

01636 **Bogard, Donald D.** Noble gases in meteorites, *in* Planetology, U.S. National Report, 1967-71, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 7, p. IUGG 429-435, 1971.

Recent work, mainly in the United States, on isotopic abundances of noble gases in meteorites is summarized under four main headings: trapped noble gases; cosmic ray interactions, radiation ages, and gas-retention ages; extinct radionuclides; and lunar studies. A bibliography of 3 + pages is given. — DBV

01645 **Bohor, B. F.; Hughes, Randall E.** Scanning electron microscopy of clays and clay minerals [with French, German, and Russian abstracts]: Clay and Clay Minerals, v. 19, no. 1, p. 45-54, illus., 1971.

The scanning electron microscope (SEM) proves to be ideally suited for studying the configuration, texture, and fabric of clay samples. Growth mechanics of crystalline units — interpenetration and interlocking of crystallites, crystal habits, twinning, helical growth, and topotaxis — also are uniquely revealed by the SEM. Authigenic kaolins make up the bulk of the examples because their larger crystallite size, better crystallinity, and open texture make them more suited to examination by the SEM than most other clay mineral types. [Shown in 28 figures are various examples from different areas and rock ages, some with effects of spray-dried preparation, some at different angles.] — Authors' abstract

01531 **Bonatti, Enrico; Fisher, David E.** Oceanic basalts — Chemistry versus distance from oceanic ridges: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 307-311, illus., table, 1971.

The major elements chemistry, as expressed by the normative composition, and the degree of silica saturation of basalts erupted at various distances from the axis of the East Pacific Ridge do not differ systematically from the same parameters of basalts erupted at the3gx0f th ridge. These results suggest that the conditions of magma generation are similar beneath ridges and away from them. — Authors' abstract

01748 **Bonatti, Enrico.** Ancient continental mantle beneath oceanic ridges: Jour. Geophys. Research, v. 76, no. 17, p. 3825-3831, illus., 1971.

The petrology, bulk chemistry, and Sr-isotopic chemistry of ultramafic rocks from the equatorial Mid-Atlantic Ridge suggest that a zone of alpine-like residual peridotitic material exists in the upper mantle beneath the Mid-Atlantic Ridge. This

originally was part of a layer of "continental" mantle located below Pangea, constituting the material left over from the differentiation of the sial from the primitive mantle. Upon rifting, the upper mantle "continental" layer is carried along by convection currents except for a central block caught in a stagnant zone at the divergence of the two rising limbs; such a block is presently beneath the Mid-Atlantic Ridge. Stagnant "continental" mantle should be present below the Atlantic and Indian ridges. — *from* Author's abstract

01937 **Bonini, William E.; Vreeland, John H.; Kelley, William N., Jr.; Clermont, Kevin.** Predicting the shape of intrusive bodies from gravity data — Crazy Mountains and Little Rocky Mountains, Montana: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 167-172, illus., 1971.

Gravitational field anomalies have been observed over many igneous intrusives of medium (4000 sq km) to small (100 sq km) size in outcrop area. These studies give good results because the residual anomalies can be separated from larger-scale crustal anomalies and density contrasts usually are present. Although unique solutions are not possible, the analysis of the gravity anomalies places important limits on both areal and depth extent of the intrusive bodies. Of all possible geophysical techniques, gravity studies offer the most promise in the determination of the shape intrusive bodies. — Authors' abstract

01800 **Bonnichsen, Bill.** Hornfelses in the southern part of the Duluth Complex, Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 11-12, illus., 1971.

Boon, J. D, 3d. *See* Harrison, W. 01955

01629 **Borchardt, G. A.; Harward, M. E.; Schmitt, R. A.** Correlation of volcanic ash deposits by activation analysis of glass separates: Quaternary Research, v. 1, no. 2, p. 247-260, illus., tables, 1971.

Volcanic ash deposits whose source is the Cascade Mountains area were correlated on the basis of 19 elemental abundances, determined by neutron activation analysis on glassy separates. A statistical method was developed for correlating on the basis of relative elemental composition unique to the ash deposits. Elemental abundances of Mazama glassy separates were independent of distance from the source. The site-to-site variability of crystal-rich Glacier Peak and St. Helens ash layers was greater than for Mazama and Newberry ashes. The Rb, Yb, Lu, Th, and Ta contents in Newberry glass were more than twice those in Mazama glass. The presence of Mazama ash was confirmed at sites in Oregon, Washington, Alberta, and in Pacific Ocean sediments. — DBV

Borcsik, M. *See* Stollery, G. 01500

01596 **Borg, I. Y.** Microscopic examination of undeformed and laboratory-deformed Wagon Wheel rocks — UCRL-51014: Springfield, Va., Natl. Tech. Info. Center, 17 p., illus., tables, 1971.

The mineralogy of shales, siltstones and wackes, grain size, modal analyses, and number of grain contacts per quartz or chert grain are given for core samples from the gas-bearing horizon of Wagon Wheel Hole No. 1 near Pinedale, Wyo. In contrast to rock at comparable horizons at Gasbuggy site near Farmington, N.M., they contain more SiO_2 and calcite, fewer rock fragments, and less clay, are coarser grained, and particles are less angular. They have more than twice as many grain contacts per grain, or potential sites of local stress concentration per unit volume, which suggests that failure is more likely to be associated with microfracturing than in Gasbuggy rock. No microfracturing was found in Wagon Wheel wackes deformed in one-dimensional tests where mean stress ranged up to 5.87 kbar. In triaxial tests at mean pressures up to 9.61 kbar 'brittle' failure shows development of single shear faults surrounded by localized zones of fracturing, 'transitional' failure is associated with broad zones of shear failure and pervasive microfracturing, and 'ductile' failure with demolition of all mechanically strong rock components and subsequent cataclastic flow. — *from* Author's abstract

01681 **Bornemisza, Elemer.** Extraction of anions and cations from recent volcanic ash: Soil Sci. Soc. America Proc., v. 35, no. 3, p. 506-507, illus., table, 1971.

Water extracts of Mt. Arenal volcanic ash, recently active in Costa Rica, contained up to 32 ppm Ca, 3.3 ppm Mg, 4 ppm K, 4 ppm Na, and 0.4 ppm Mn. Sulfates reached 35 ppm and silicates 1.6, but no phosphates were extracted. The samples taken farthest fromthe volcano were lowest in Ca and Mg. The pH of titration series decreased on standing by up to 1.5 pH units. — Soil Brief

01443 **Bornhold, Brian D.; Pilkey, Orrin H.** Bioclastic turbidite sedimentation in Columbus Basin, Bahamas: Geol. Soc. America Bull., v. 82, no. 5, p. 1341-1354, illus., tables, 1971.

Turbidity currents, originating on the upper parts of the steep slopes of the shallow carbonate banks, have flowed a maximum of 15 mi into the basin, dominantly from the northeast and the northwest. These flows have occurred with a frequency of about one every 3000 to 6000 yr and have resulted in turbidites with volumes of the order of $10^8 m^3$. Individual flows are tongue shaped, and there is some indication that the thickest portions are near the head of the flow. Relatively little fine material is deposited in the basin by turbidity currents. Marked lateral changes were observed with increasing distance of transport from source as well as distance from flow axis: (1) decrease in turbidite thickness; (2) decrease in abundance of *Halimeda*, oöids, and pellets; (3) increase in relative abundance of planktonic forams; (4) decrease in abundance of high-magnesium calcite and an increase in abundance of low-magnesium calcite. — *from* Authors' abstract

Bornstein, Ann. *See* Heuzé, Francois E. 01893

Botinelly, Theodore. *See* Neuerburg, George J. 01931

Bottino, M. L. *See* Schnetzler, C. C. 01880

Boucot, A. J. *See* Berry, W. B. N. 08748

Boucot, A. J. *See* Klapper, Gilbert. 08749

Boucot, A. J. *See* Ziegler, A. M. 08762

Bowin, C. O. *See* Uchupi, Elazar. 01795

01532 **Bowles, Frederick A.; Angino, Ernest A.; Hosterman, John W.; Galle, O. Karmie.** Precipitation of deep-sea palygorskite and sepiolite: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 324-332, illus., tables, 1971.

Five of 34 dredge hauls taken in the Atlantic Ocean recovered a material tentatively described on shipboard as a 'salmon-colored clay.' X-ray diffraction analyses showed the clay material to consist principally of palygorskite. Occurring with the palygorskite are quartz, calcite, and dolomite. It is suggested that the palygorskite (and sepiolite) is the result of chemical precipitation brought about by the reaction of hydrothermal solutions with sea water. — Authors' abstract

08731 **Boyle, R. W.** The source of metals and gangue elements in hydrothermal deposits, *in* Problems of hydrothermal ore deposition; the origin, evolution and control of ore-forming fluids — Symposium, St. Andrews, Scotland, 1967: Stuttgart, Germany, E. Schweizerbart'sche Verlagsbuchhandlung (Internat. Union Geol. Sci., Ser. A, no. 2), p. 3-6, 1970.

Discussing four possibilities that have been considered since the time of Agricola, and evidence in published reports on a number of Canadian mines, this writer is of the opinion that metals, gangue elements, and volatiles in hydrothermal deposits came from the country rocks that enclose, lie below, or lie lateral to the deposits. From their sites in the country rocks the elements were mobilized during metamorphism or were collected by deep-seated circulating ground or connate waters. Most elements probably migrate by diffusion and are concentrated by the action of dilatant

structures or as a result of chemical reaction with favorable rocks such as limestones. These mechanisms are outlined in the papers given as references, and in a communication to the previous Symposium on postmagmatic ore deposition (Boyle, 1963). — GDC

08759 **Boyle, R. W.** Regularities in wall-rock alteration phenomena associated with epigenetic deposits, *in* Problems of hydrothermal ore deposition; the origin, evolution and control of ore-forming fluids — Symposium, St. Andrews, Scotland, 1967: Stuttgart, Germany, E. Schweizerbart'sche Verlagsbuchhandlung (Internat. Union Geol. Sci., Ser. A, no. 2), p. 233-259, 1970.

Most common high-temperature alterations are fenitization, skarnification, greisenization, feldspathization, and tourmalinization; most low-temperature types are sericitization, silicification, chloritization, pyritization, argillization, carbonatization, and serpentinization. Regularities occur with respect to types of wall rocks and deposits, and to mineralogical and chemical zonation; timing of mineralization in a geologically short surge, or in a complex series of waves or pulses punctuated by repeated fracturing, depends on types of deposits. Wall rock alterations suggest that the mineralizing medium in most epigenetic deposits was predominantly aqueous, CO_2 and S playing a large part. The pH of the medium was in some cases acidic and changed to a neutral or alkaline state by reaction with wall rocks, in other cases was predominantly neutral. — *from* Author's abstract

01930 **Brabec, D.** Aqua regia extractable vs. total copper and zinc content of granitic rocks: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 94-97, illus., tables, 1971.

Previous studies have demonstrated the possibility of using aqua regia extractable copper and zinc in plutonic rocks in exploration geochemistry. The present investigation compares this method of extraction with hydrofluoric-perchloric acid attack and bisulfate fusion in terms of precision and discrimination between high and low concentrations. Statistical treatment of data shows that the overall performance of the aqua regia method compares very favorably with other methods of attack. — Author's abstract

01517 **Bracewell, Bobby L.; Veigele, William J.** Tables of X-ray mass attenuation coefficients for 87 elements at selected wavelengths, *in* Developments in applied spectroscopy, V. 9 (E. L. Grove; A. J. Perkins, editors): New York, London, Plenum Press, p. 357-400, illus., tables, 1971.

Tables of X-ray mass attenuation cross sections have been prepared for 87 elements with atomic numbers between one and 94 at 99 selected wavelengths of interest to spectroscopists, microprobe users, diffraction workers, etc. Tables were derived from a recent X-ray cross section compilation covering the energy range 0.1 KeV to 1 MeV. A brief description is given of the assumptions and methods used in preparing the original compilation to point out limitations of the derived tables. — Authors' abstract

08739 **Bradshaw, R. L.; Lomenick, T. F.** Rheology of salt in mine workings, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 109-123, illus., 1970.

[In the interest of radioactive waste disposal into salt mines] studies of rheological behavior of salt around mine openings, and in laboratory "pillar models", included effects of pillar stress (to more than 10,000 psi), temperature (to 200°C), time (measurements of to 5 years' duration in openings up to 40 years old, and pillar-model tests to more than 2 years' duration), pillar size and shape, and location of shale partings. Results of pillar-model tests can be extrapolated to, and help explain, mine conditions both qualitatively and quantitatively. Floor-to-ceiling convergence rates (creep rates) in mines and models indicate pillar stresses. Creep rates decrease with time (rapidly, then more slowly), increase markedly with temperature, and are strongly influenced by locations of shale partings. — *from* Authors' abstract

Brashear, H. R. *See* Acree, E. H. 02000

02001 **Brashear, H. R.; Acree, E. H.; Case, F. N.; Turner, P. A.; Duane, D. B.** Processing and analysis of radioisotopic sand tracer (RIST) study data, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 821-830, illus. [1971].

Data collected during Radioisotopic Sand Tracer (RIST) field tests are processed through digital computers. Data treatment requires computing and plotting the detector position and correcting corresponding radiation count rates for radioactive decay. Field data are recorded on punched paper tape which is edited and transferred to magnetic tape. Navigation data, in the form of distances to shore-based microwave responder beacons, are tested for spurious values by comparison with theoretical maximum travel distances of the survey vehicle between successive fixes. Navigation ranges are converted to rectangular geographic coordinates. The ultimate goal is to obtain an estimate of mean direction and volume of littoral transport and a radiation material balance to be used to check the results. — *from* Authors' abstract

01588 **Breeze, Arthur F.** Abnormal-subnormal pressure relationships in the Morrow sands of northwestern Oklahoma: Shale Shaker, v. 21, no. 8-9, p. 172-193, illus., table, 1971.

In this area within the Interior Plains and Central Lowland physiographic province, Morrow sediments of early Pennsylvanian age contain sandstone beds that are prolific producers of oil and gas. The range of reservoir pressures shown on the regional tectonic map defines the problem — that of seeking an explanation for the significant pressure transition in essentially similar reservoirs. A review of the major sources of reservoir pressure suggests that osmosis is a likely cause of the pressure lowering in evidence. Overpressures are mainly due to compactive phenomena. By studying a combination of factors — shale properties from well-logs, formation water salinities, changes in geothermal gradients — the influence of such factors as porosity, salinity, clay mineral content that may affect one or more techniques can be offset, and a better understanding of compaction can be obtained. — EHS

Breslau, Lloyd R. *See* Johnson, Thomas C. 01633

01594 **Bretsky, Sara S.** Evaluation of the efficacy of numerical taxonomic methods — An example from the bivalve mollusks: Systematic Zoology, v. 20, no. 2, p. 204-222, illus., tables, 1971.

Phenetic and phylogenetic classifications of 42 Tertiary and Recent species of the family Lucinidae correspond well only at lower taxonomic levels. On the basis of evolutionary relations, these species can be assigned to 28 subgenera and 7 genera. In the phenetic study, 45 multistate, mostly qualitative characters were used to calculate correlation and distance coefficients; both similarity measures were clustered by the weighted pair-group method. Small clusters which formed at high similarity levels in the two phenograms were usually composed of species of one, or two or three closely related subgenera; however, major clusters differed considerably between phenograms and from the principal phylogenetic lineages (genera). Phylogenetic classifications, being hypotheses about genealogy rather than static descriptions of morphological similarity, are more likely than phenetic ones to be productive of future investigations. — *from* Author's abstract

Briggs, Darinka Zigic. *See* Briggs, Louis I. 08767

08767 **Briggs, Louis I.; Briggs, Darinka Zigic.** Digital simulation models of evaporite sedimentation, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 3-23, illus., table, 1970.

Computer simulation can define environmental factors that control the nature and distribution of evaporite facies, through definition and dimensioning of model parameters. The objective is to define appropriate environmental process functions and lithologic parameteric values to produce facies patterns equivalent to the

specific state of the stratigraphic concept being modeled. In petroleum exploration it is important to determine factors that controlled the nature and distribution of lithologies in stratigraphic units related to oil deposits. The model for experiments to reproduce evaporite facies of the Louann salts of the Gulf of Mexico only approximates the equivalent specific state of the stratigraphic facies. Results suggest modification of both the paleogeographic concepts of the Jurassic and the simulation model parameters. — GDC

01447 **Brock, Thomas D.** Bimodal distribution of pH values of thermal springs of the world: Geol. Soc. America Bull., v. 82, no. 5, p. 1393-1394, illus., table, 1971.

Frequencies of thermal springs of various pH values are given for the main thermal areas in Yellowstone Park, other parts of the western United States, New Zealand, and Iceland. A bimodal distribution curve was obtained for many springs with pH values of 2-4 and 7-9 but relatively few in between. These data provide quantitative evidence for the existence of two main kinds of thermal springs: acid sulfate and neutral bicarbonate. — Author's abstract

01537 **Brodkorb, Pierce.** Catalogue of fossil birds — Pt. 4, (Columbiformes through Piciformes): Florida State Mus. Bull. Biol. Sci., v. 15, no. 4, p. 163-266, 1971.

Pt. 4 treats 36 families (4 extinct; 32 living), 146 genera (48; 98), and 300 species (141; 159), in 11 orders: Columbiformes, Cuculiformes, Psittaciformes, Strigiformes, Caprimulgiformes, Apodiformes, Trochiliformes, Coliiformes, Trogoniformes, Coraciiformes, Piciformes. Proposed new taxa are: family Zygodactylidae for *Zygodactylus* Ballmann in Piciformes; subfamily Apopempsinae and genus *Apopempsis* for *Musaphaga maini* Ballmann in Musophagidae; genus *Eostrix* for *Protostrix mimica* Wetmore in Protostrigidae. By priority, the following subfamily names replace those in Peters' check-list: Ptilinopinae for Treroninae; Coccyginae for Phaenicophaeinae; Geococcyginae for Neomorphinae; Atelornithinae for Brachypteraciinae. In addenda to Pts. 1-3 (Brodkorb, 1963, 1964, 1967), 49 species are added. Pts. 1-4 have treated all orders but Passeriformes, and cover 132 families (38 extinct; 94 living), 744 genera (404; 340), and 1,522 species (898; 624). — VMJ

01632 **Broecker, W. S.** A kinetic model for the chemical composition of sea water: Quaternary Research, v. 1, no. 2, p. 188-207, illus., tables, 1971.

Thermodynamic ocean models of the Sillen school predict a uniform chemical composition during Cenozoic time. However, as sediments presently accumulating show little evidence of equilibration with the overlying water, the possibility that kinetic factors play an important role must be seriously explored. Such a model is presented here. The role of organisms is dominant for at least some of the important components of sea salt. If sea-water chemistry depends on rates of supply of individual components, the rate of vertical mixing, and the type of material formed by organisms, then substantial changes in chemical composition must have taken place. Several ways of reconstructing such changes from chemical and isotopic (C-13/C-12) measurements on marine sediments are discussed. — DBV

Broecker, W. S. *See* Thurber, D. L. 08744

02087 **Broecker, Wallace S.** Calcite accumulation rates and glacial to interglacial changes in oceanic mixing, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 239-265, illus., tables, 1971.

By contrasting $CaCO_3$ accumulation rates between glacial and interglacial intervals at places on the sea floor, it should be possible to place restrictions on the degree to which oceanic mixing changes with climate. The first step is to relate observed rates to the present-day mode of oceanic mixing and to ascertain sensitivity of these rates to changes in this scheme. Next, rates of accumulation during interglacial and last glacial periods are compared in the central North Atlantic, equatorial Atlantic, Caribbean, equatorial Indian, and equatorial Pacific oceans. The total rate of $CaCO_3$ accumulation remains nearly constant in all these areas, but that of foraminiferal

shells is distinctly lower during glacial than interglacial time in the Atlantic, and the reverse in the Pacific. Finally, means of separating influences of ecologic and solution effects from those of mixing are discussed. — *from* Author's summary

Brooks, E. R. *See* White, W. S. 01849

Brooks, H. K. *See* Purdy, Barbara A. 01771

01655 **Brown, E. T.; Hudson, J. A.; Hardy, M. P.; Fairhurst, C.** Controlled failure of hollow rock cylinders in uniaxial compression: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 1-32, illus., tables, 1971.

Detailed consideration is given to the behavior of hollow rock cylinders loaded in uniaxial compression. Elastic stress distributions calculated by the finite element method show that radial stresses are considerably lower in hollow than in solid cylinders, and that the uniformity of the stresses can be improved considerably by using loading platens having the same cross-section as the specimen. Servo-controlled uniaxial compression tests carried out on solid and thick-walled cylinders of white Tennessee marble show no essential differences in the behavior of the two specimen types with similar strengths and fracture phenomena being observed. In tests carried out in servo-controlled, stiff, and conventional machines, the progressive formation of large numbers of short subaxial cracks is followed by the development of macrofractures such as slabbing and shearing well past the peak of the stress-strain curve. — Authors' abstract

Brown, E. T. *See* Hudson, J. A. 01656

01665 **Brown, E. T.** Strength-size effects in rock material: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 138-150, illus., table, 1971.

It has not yet been conclusively demonstrated that the mechanical properties of rock materials vary with test specimen size, for a wide range of rock materials. Most of the apparent experimental verifications of the size effect hypothesis are reflections of constraints imposed by the testing system and do not represent intrinsic material properties. Many arise from the existence of stress gradients within test specimens. In uniformly loaded hard rock specimens free of microfissuring and above a small minimum in size, a true size effect is unlikely to exist. Attempts to account for a size effect in compressive strength of rock using Weibull's theory are fallacious because they oversimplify the original theory and apply it to situations other than those for which it was proposed. — DBV

02009 **Brown, M. C.; Ford, D. C.** Quantitative tracer methods for investigation of karst hydrologic systems, with special reference to the Maligne Basin area, Canada: Cave Research Group Great Britain Trans., v. 13, no. 1, p. 37-51, illus., tables, 1971.

Quantitative tracer methods are reviewed and evaluated. The theory of karst flow networks is tested in a case study of the Maligne River basin in western Alberta. The river sinks at Medicine Lake, 10 miles above the Athabasca junction, and rises from large springs in the Devonian Palliser Limestone within and downstream from Maligne Canyon. Tracer tests were carried out at Medicine Lake in 1966, 1967, 1968, and 1970, using Rhodamine B, Fluorescein, and Rhodamine WT (last two tests); some dye was recovered in all but the second test. Dye flow-through time, measured at Main Risings and Hatchery Pools at a lower elevation, differed with varying lake stage and seasonal discharge, suggesting that reliable quantitative analyses by dye tracer must be based on repeated testing. Results are consistent with a modified "type 4" karst flow network system, which has both additional inputs and outputs. Some dye loss may be due to adsorption on suspended sediment. — VMJ

Brown, R. F. *See* Keys, W. S. 01436

Brown, R. F. *See* Keys, W. S. 08770

Brown, R. J. S. *See* Holser, W. T. 02037

Brown, W. S. *See* Swanson, S. R. 01970

08718 **Brune, Gunnar.** The Texas Water Development Board cooperative studies of the Ogallala underground reservoir, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 217-242, illus., 1970.

The first study, in cooperation with the High Plains Research Foundation, uses recharge and observation wells to evaluate the effects on the aquifer of using runoff water to recharge wells. The objective is to ascertain whether present methods of maintaining recharge wells and desilting recharge water are adequate. The second, in cooperation with the U.S. Geological Survey, contemplates possible use of the Ogallala reservoir for underground storage and transmission of imported or local surface water; the planned program is outlined. — DBV

Bryan, A. M. *See* Olafsson, P. G. 01522

Bryan, W. B. *See* Craig, J. R. 02066

01414 **Bryant, Bruce.** Movement measurements on two rock glaciers in the eastern Elk Mountains, Colorado, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B108-B116, illus., table, 1971.

On two cirque rock glaciers at 11,500-12,000 feet in altitude at lat 39°00′ N. in the eastern Elk Mountains of Colorado, maximum surface movement amounted to about 2 feet (60 cm) per year over a 4-year period. Practically no disruption of their surface cover took place during that period, and little change along surface profiles was detected. In both rock glaciers there appeared to be a lateral component of movement away from the highest valley wall. — Author's abstract

Brydon, J. E. *See* Shimoda, S. 01646

01487 **Bubeck, Robert C.; Diment, William H.; Deck, Bruce L.; Baldwin, Alton L.; Lipton, Stewart D.** Runoff of deicing salt — Effect on Irondequoit Bay, Rochester, New York: Science, v. 172, no. 3988, p. 1128-1132, illus., 1971.

Salt used for deicing the streets near Rochester, New York, has increased the chloride concentration in Irondequoit Bay at least fivefold during the past two decades. During the winter of 1969-70 the quantity and salinity of the dense runoff that accumulated on the bottom of the bay was sufficient to prevent complete vertical mixing of the bay during the spring. Comparison with 1939 conditions indicates that the period of summer stratification has been prolonged a month by the density gradient imposed by the salt runoff. — Authors' abstract

Bucher, Jane L. *See* Leisman, Gilbert A. 02048

02086 **Buckley, D. E.; Cranston, R. E.** Atomic absorption analyses of 18 elements from a single decomposition of aluminosilicate: Chem. Geology, v. 7, no. 4, p. 273-284, illus., tables, 1971.

The atomic absorption determinations of 18 elements in aluminosilicate minerals and marine sediments is accomplished after a single decomposition method using hydrofluoric acid and aqua regia. The digested sample is combined with boric acid to give a 100 ml solution from which all 18 elements including Si, Ti, V, and Al can be determined directly by means of atomic absorption spectroscopy. Inter-element interferences and ionization effects are fully compensated by using combined standards having a matrix similar to that of the samples. Precision and accuracy for most determinations are comparable to the other more complex analytical techniques while the speed of analysis is considerably faster than existing methods. — Authors' abstract

Buckmelter, James R. *See* Lipson, Herbert G. 01518

Bunker, Carl M. *See* Lachenbruch, Arthur H. 01703

01860 **Bunker, Willard F.** Mineral industry and the geologist: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 786-791, illus., 1971.

In the face of soaring demands for minerals and the increasingly difficult task of finding new deposits, the geologic profession is aging and continues to decline and the extractive mineral industries expect to employ 15 percent fewer geologists and geophysicists by 1975. Demand for a mineral is cyclic and companies reduce staff during low cycle. However, geologists are trained to look for favorable mineral environments and companies now beginning to diversify should switch their geologic effort to exploration for minerals in current demand. A consistent industry recruiting program is needed. Exploration organizations must stress teamwork and must define the role of geologists more specifically. To regain control of his data the geologist must master the arts of rapid data processing, synthesis, and meaningful display. — BHK

01667 **Burch, C. R.; Murgatroyd, P. N.** Broken-line and complex frequency distributions: Internat. Assoc. Math. Geology Jour., v. 3, no. 2, p. 135-155, illus., tables, 1971.

Broken straight lines on probability paper have been proposed as representing cumulative probability distributions of SiO_2, Na, and Cl in certain plutons. This corresponds to pairs of complementarily truncated normal or lognormal distributions. It is shown that alternative representations, such as pairs of overlapping complete normal or lognormal distributions, yield fits equally acceptable statistically if the sample selection is random. The method also yields a good description of distributions described as "complex." Computer methods of optimizing the free parameters are used. Significance testing is discussed in detail. It is stressed that, although significance testing is helpful, it can neither relieve the geochemist of the burden nor take from him the privilege of being independent and forming his opinion on the total evidence. — Authors' abstract

Burchfiel, B. C. *See* Davis, Gregory A. 01460

Burke, E. A. J. *See* Harris, D. C. 01897

Burlingame, A. L. *See* Haug, Pat. 01578

01637 **Burnett, D. S.** Formation times of meteorites and lunar samples, *in* Planetology, U.S. National Report, 1967-71, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 7, p. IUGG 435-440, 1971.

This paper reviews meteorite age measurements of the past four years, summarizes the state of the art through 1970, and discusses age measurements on lunar samples. It is known with a very high degree of certainty that almost all meteorites, the Earth, and undoubtedly the Moon formed at the time of the isolation of the solar system around 4 b.y. ago. The isotopic relationships in lunar samples appear to be somewhat more complex than those in meteorites, but this complexity promises to be rich in information about the evolution of the Moon. A bibliography of almost 2 pages is given. — DBV

01727 **Burnett, John L.** Geology of the Lake Tahoe basin: California Geology, v. 24, no. 7, p. 119-127, illus., 1971.

Evidence suggestive of the fault origin of the Tahoe basin in Nevada is seen in the presence of a hot spring close to the contact between the granitic and volcanic rocks, of fault scarps on the east and west sides of the basin, and of vertical displacement along the scarps. Lake Tahoe occupies a depression, or graben, between the two crests of an upfaulted mountain system. Geologic units present in the basin are folded pre-Cretaceous metamorphic rocks which are enclosed within granitic intrusives, together forming the basement rocks. Cenozoic volcanic rocks form a thick section at the lake outlet and cap the high peaks thinly. Quaternary glacio-fluvial deposits fill the valleys. — EH

01728 **Burnett, John L.; Matthews, Robert A.** Geological look of Lake Tahoe: California Geology, v. 24, no. 7, p. 128-129, illus., 1971.

This road log of the geology of the Lake Tahoe area starts at the California-Nevada border on U.S. Highway 50 and proceeds eastward around the lake in a counterclockwise direction to the starting point. — EH

01642 **Butler, Howell M.** Palmer seismological observatory: Earthquake Notes, v. 42, no. 1, p. 15-36, illus., 1971.

The functions of the Palmer Observatory, in south-central Alaska, which is headquarters for the Alaska Regional Tsunami Warning System and is the Alaska Regional Seismological Center, include detection and location of major earthquakes in the northern Pacific region and, if necessary, immediate issuing of earthquake and tsunami information and warnings, and also the provision of seismic data from the 11 seismic stations recorded at the observatory. Seismograph, tide-gage, timing and alarm systems, seismic and tidal analysis, and the analysis of teleseisms, and data collection, evaluation and dissemination are described. EH

01485 **Butler, Robert F.; Cox, Allan V.** A mechanism for producing magnetic remanence in meteorites and lunar samples by cosmic-ray exposure: Science, v. 172, no. 3986, p. 939-941, illus., table, 1971.

An irradiation of 3×10^{17} neutrons per sq cm in a reactor core produced an increase in the coercive force of iron and kamacite of 16 to 21 percent. The alternating-current demagnetization spectrum of saturation isothermal remanence was shifted toward higher coercive forces. Similar neutron fluences produced by cosmic-ray exposure may be capable of converting soft isothermal remanence in meteorites and lunar samples to remanence with a high coercive force. — Authors' abstract

Byrne, R. J. *See* Harrison, W. 01955

02053 **Cadle, R. D.; Wartburg, A. F.; Grabek, F. E.** The proportion of sulfate dioxide in Kilauea volcano fume: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 503-507, illus., table, 1971.

Particles collected from the fume of Kilauea volcano are largely dilute sulfuric acid droplets containing dissolved salts. The concentrations of salts in the droplets vary markedly depending on the volcanic conditions where collection occurs. A technique has been developed for determining the proportion of sulfate to sulfur dioxide in such fume. Very large variations in these proportions have also been found. All of these variations can be explained as being due to varying degrees of oxidation of H_2S, S and SO_2 at high temperatures by atmospheric oxygen. If such oxidation occurs during extremely explosive eruptions, such as that of Ganung Agung in Bali, large amounts of sulfuric acid droplets containing various sulfates may be injected directly into the stratosphere. Since such droplets are in the micron and submicron size range, they will remain in the stratosphere for long time periods. — Authors' abstract

01556 **Cailleux, André.** Lacs en ourson, cernes et thermokarst [Bear-cub and marginate lakes and thermokarst]: Cahiers Géographie Québec, v. 15, no. 34, p. 131-136, illus., 1971.

Bear-cub and marginate lakes are common in outwash plains in Quebec north of 50-51° N. Their deeper parts may have a kettle-hole origin. Their shallow margin is interpreted as a former part of the outwash plain, originally located above lake level and having contained segregation ice. In summer the lake water melted the ice, the plain subsided and the water invaded it. Therefore the margin is shallow and the outlines are circular or arc-shaped (bear-cub). All these factors point to a thermokarst (incavation) origin. — *from* Author's abstract

01982 **Calder, John A.; Attaway, David H.** Preliminary studies of stable carbon isotopes in selected Kansas shales: Kansas Geol. Survey Bull. 202, pt. 1, p. 19-21, tables, 1971.

Ratios of stable carbon isotopes were measured on chemical fractions of four Kansas shales. Content of organic carbon and relative abundance of chemical fractions were also determined. Relationships and meaning of the data are discussed. Distribution of

stable isotopes of carbon is a geochemical parameter often used to indicate environment of deposition, relationships between petroleum and source rocks, and extent of *in situ* alteration of organic molecules. Samples studied in this investigation were the Sharon Springs Shale Member (Upper Cretaceous), Graneros Shale (Upper-Lower Cretaceous), and the Heumader and Heebner Shale Members (Upper Pennsylvanian). — *from* Authors' abstract

08720 **Callomon, J. H.** Geological map of Carlsberg Fjord-Fossilbjerget area: Medd Grönland, v. 168, no. 4, 9 p., illus., geol. map, scale 1:100,000, 1970.

A week of reconnaissance was made late in the 1958 summer field season, for subsequent expeditions to be led by Lauge Koch to explore Mesozoic geology of northern Jameson Land. Jurassic rocks were found to occur widely, were locally very fossiliferous, and differed in faunas and facies from those better known in southern Jameson Land. New place names were vaguely located, and one was given to the Fossilbjerget Formation of undetermined age, extent and co-relationships; there were references to a Jurassic Eldorado, plateaux spread with "thousands of ammonites". This 1958 expedition was Koch's last. Summarized here are the mapped formations; beds are almost all horizontal; and their boundaries, governed by topographic relief, are filled in with the aid of oblique aerial photographs, on which were seen the Tertiary basalt dikes shown. Sills are absent except in NW corner; no fault is apparent. — GDC

01505 **Camfield, P. A.; Gough, D. I.; Porath, H.** Magnetometer array studies in the northwestern United States and south-western Canada: Royal Astron. Soc. Geophys. Jour., v. 22, no. 2, p. 201-221, illus., 1971.

Time-varying magnetic fields were recorded in 1969 in northwestern United States and southwestern Canada. Magnetograms and maps of Fourier spectral components of three magnetic events are used to describe conductive structures in the upper mantle and crust. The most prominent anomaly is the Central Plains anomaly, from the eastern edge of the Black Hills northward to the Williston Basin. It indicates a crustal conductor which concentrates current induced in a large region. In the western part of the array, attenuation of the vertical variation fields is attributed to a westward rise in the highly-conducting mantle. Small anomalies over the eastern front of the Northern Rockies and the Rocky Mountain Trench may be associated with ridges or steps on the upper-mantle conductor or with crustal features. — DBV

Campbell, E. Y. *See* Greenland, L. Paul. 01424

01567 **Cannon, Helen L.** The use of plant indicators in ground water surveys, geologic mapping, and mineral prospecting: Taxon, v. 20, no. 2-3, p. 227-256, illus., tables, 1971.

Plants have many uses in interpreting geological phenomena: species assemblages and plant density for mapping strata of different chemical composition and water-holding capacity; halophytes outlining saline areas, salt domes, and boron deposits; plants that require unusual amounts of sulfur, for gypsum and sulfide deposits. Species adapted to living in mineralized ground, successfully used worldwide in prospecting, include indicators of selenium, uranium, zinc, copper, and cobalt. Toxic effects and physiologic and morphologic changes in plants due to unusual amounts of metals in the soil have been observed. Along with studies in plant distribution and growth changes, there should be analyses of plants and soils to determine chemical controls and precise delineation of mineralized ground. Research is needed on use of plants by geobotanists in search for ore deposits under thick soils or layers of barren rock. — GDC

Carmichael, I. S. E. *See* Stormer, J. C. 01812

Carter, N. L. *See* Raleigh, C. B. 01876

Carter, Neville L. *See* Ave'Lallement, Hans. 02023

Case, F. N. *See* Acree, E. H. 02000

Case, F. N. *See* Brashear, H. R. 02001

01950 **Castanho, José.** Influence of grain size on littoral drift, *in* Coastal engeneering—V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 891-898, illus. [1971].

Influence of grain size in sediment transport depends on flow conditions. For bed load transport a maximum probably exists for load discharge as a function of grain size. The important parameter seems to be the ratio t_c/t between the threshold shear stress and the flow shear stress. — Author's abstract

Catanzaro, E. J. *See* Hanson, G. N. 01824

Cazeau, Charles J. *See* Kalder, Michael. 01892

01650 **Centolanzi, Frank J.** Reply [to comments by Chi-Yu King on "Maximum tektite size as limited by thermal stress and aerodynamic loads" (1969)]: Jour. Geophys. Research, v. 76, no. 17, p. 4054, 1971.

For paper under discussion see ibid., v. 74, no. 27, p. 6723-6736, 1969; Abs. North American Geology, June 1970.

01894 **Černý, P.; Turnock, A. C.** Niobium-tantalum minerals from granitic pegmatites at Greer Lake, southeastern Manitoba: Canadian Mineralogist, v. 10, pt. 5, p. 755-772, illus., tables, 1971.

In zoned beryl-bearing pegmatites in the Precambrian of the Winnipeg River area, pseudo-ixiolite and microlite are the most widespread Nb-Ta minerals, niobian rutile and cassiterite, less frequent, and fersmite and ilmenite, rare. Pseudo-ixiolite has mostly high Mn-Fe, and intermediate Ta-Nb ratios. Niobian rutile shows advanced exsolution of columbite and large unit cell dimensions. Fersmite replaces pseudo-ixiolite in the Huron Claim pegmatite. Cassiterite contains numerous columbite inclusions. A positive correlation exists between the Mn-content of pseudo-ixiolite and the Li-content of the parent pegmatite; pseudo-ixiolites from Li-bearing pegmatites are also rich in Ta. Fe-rich pseudo-ixiolite occurs in the *RE*- rich Huron Claim pegmatite. Microlite occurs as a replacement of Mn-rich pseudo-ixiolite, but coexists with Fe-enriched oxides. Cassiterite occurs mainly in the Li-rich pegmatites. — *from* Authors' abstract

01736 **Chadwick, Brian.** Preliminary account of the geology of south-east Renland, Scoresby Sund, East Greenland: Grönlands Geol. Undersögelse Rap. 34, 32 p., illus., tables, geol. map, 1971.

South-east Renland occupies an internal position in the Caledonian orogenic belt of East Greenland. The area comprises migmatized paragneisses of Caledonian supracrustal origin intruded by concordant sheets of garnetiferous augen granite in the west. The gneisses and granites are folded in large-scale, tight to isoclinal folds. Intermediate igneous rocks with charnockitic affinity were intruded after the folding. The principal intrusion is an extensive, concordant sheet delimiting an area of gneisses in the east that have undergone further migmatization and granite intrusion. Prominent among the many fractures are normal faults with downthrow to the east. No indications of economic mineralization were observed. — Author's abstract

01730 **Chamney, T. P.** Tertiary and Cretaceous biostratigraphic divisions in the Reindeer D-27 borehole, Mackenzie River Delta: Canada Geol. Survey Paper 70-30, 43 p., illus., tables, 1971.

Twenty-three biostratigraphic divisions are interpreted from microfossils from the 12,668-ft deep Reindeer D-27 borehole, the first exploratory well drilled on the Mackenzie Delta, which penetrated an abnormally thick sequence of Tertiary and Cretaceous sandstones, shales, and mudstones. Thirteen provisional age assignments are interpreted from first (highest) appearances of foraminifera; the oldest strata are assigned a late Neocomian age. Four known regional Cretaceous zones are recognized in Divisions 7, 9, 11C, and 13 — *Trochammina ribstonensis*, *Verneuilinoides*

borealis, Miliammina manitobensis, Haplophragmoides gigas, in descending order. Other microfossils, especially Radiolaria, and physical stratigraphy support the divisions. Exploration for potential sandstone reservoirs should be oriented toward arcuate sandstone bars subparallel to the Early Cretaceous shoreline, for the 12,668-9,000-ft interval and, above 9,000 feet, toward fluviatile-deltaic deposits. — VMJ

Chauvel, Jean-Jacques. *See* Dimroth, Erich. 01802

08751 **Chen, J. C.** Mineralogy and chemistry of hydrothermally altered rocks from Puerto Rico: Acta Geol. Taiwanica, no. 14, p. 53-62, illus., tables, 1970.

Hydrothermally altered rocks from a steeply-dipping 2,000-ft drill core located at the border of Utuado pluton, Puerto Rico, have been studied mineralogically and chemically. The hydrothermal alteration transforms parts of the tonalitic wall rocks into light-colored, easily disintegrated, quartz-chlorite-sericite-pyrite rocks. Potassium, iron, and copper contents increased while sodium and calcium contents generally decreased as a result of the alteration. The magnesium contents in the parent rocks were not strongly changed. The variations of sodium and potassium with depth in the hydrothermally altered rocks from the core are interpreted as reflecting the exchange of sodium and potassium between the hydrothermal fluid and the tonalitic wall rocks. — Author's abstract

01575 **Chesworth, Ward.** Laboratory synthesis of dawsonite and its natural occurrences: Nature Phys. Sci., v. 231, no. 19, p. 40-41, illus., 1971.

The aluminum amalgam technique allows construction of a synthesis diagram which is clearly applicable to authigenic occurrences of dawsonite. Experimental work confirms that a highly alkaline environment is necessary for dawsonite formation. — DBV

01767 **Chesworth, Ward.** Metamorphic conditions in a part of the Haliburton Highlands of Ontario: Lithos, v. 4, no. 3, p. 219-229, illus., tables, 1971.

Metamorphism in the Haliburton Highlands is of Miyashiro's low pressure, intermediate type. Physico-chemical conditions ranged from 3.5 to 7 kilobars total pressure and 580 to 700°C. — Author's abstract

02075 **Chiang, Sie Ling.** A runoff potential rating table for soils: Jour. Hydrology, v. 13, no. 1, p. 54-62, tables, 1971.

A runoff potential rating table based on the soil catena concept is proposed to group soils of similar runoff potential. Seven runoff potential ratings are given according to internal drainage, depth and texture of the soil, as well as subsurface soil conditions. The proposed rating table is to be applied to a detailed soil survey. In the absence of adequate soil reports, an air photo analysis approach is also tentatively suggested in conjunction with the use of the proposed system. The rating system enables engineers to classify soils hydrologically. — Author's abstract

01752 **Christensen, Nikolas I.; Ramanantoandro, R.** Elastic moduli and anisotropy of dunite to 10 kilobars: Jour. Geophys. Research, v. 76, no. 17, p. 4003-4010, illus., tables, 1971.

Elastic wave velocities are reported for several directions at pressures to 10 kb in two samples of dunite from the Twin Sisters peaks, Washington. In dunite A, with a strong concentration of olivine *a* axes and girdles of *b* and *c* axes, longitudinal velocity at 10 kb is 8.76 kmps parallel to and 7.98 kmps normal to the *a* axes maximum; in the latter direction, two transverse waves are clearly transmitted. In dunite B, with strong concentrations of all three crystallographic axes, longitudinal velocity is 9.15 kmps at 10 kb along the *a* axes maximum and 7.83 kmps along the *b* axes concentration. Elastic stiffnesses and compliances and the physical properties of isotropic aggregates of the dunites were calculated. Primarily because of accessory minerals, Voigt and Reuss velocities are lower than values computed from single-crystal data. — DBV

02073 **Christensen, Nikolas I.** Fabric, seismic anisotropy, and tectonic history of the Twin Sisters dunite, Washington: Geol. Soc. America Bull., v. 82, no. 6, p. 1681-1694, illus., tables, 1971.

Olivine orientation and seismic anisotropy at confining pressures of 0.1 to 10.0 kb have been studied for 14 samples collected from the Twin Sisters dunite. At 10 kb, the dunites show differences in compressional wave velocities with propagation direction ranging from 0.03 to 0.92 kmps. All samples were geographically oriented in the field, and the measured velocities have been related to the geographic orientations. The results show a complex but definite pattern of anisotropy throughout the body in which the slow velocities tend to be horizontal and normal to the elongation of the body. Mean velocities in a vertical direction are slightly higher than mean north-south velocities. — *from* Author's abstract

08710 **Claborn, B. J.; Austin, T. Al; Wells, D. M.** Numerical model of the Ogallala as a management tool, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 89-110, illus., tables, 1970.

The digital computer has made possible numerical models of ground-water basins which by-pass two objections to resistance-capacitance models. Several such models have been constructed. This paper adapts the model constructed for application in the Riverside-Chino Basin area of Los Angeles County in California to a portion of the southern High Plains of Texas. A management application example is given. — DBV

Clark, R. S. *See* Rowe, M. W. 01694

Clark, R. S. *See* Bogard, D. D. 01879

01568 **Clarke, James W.; Heron, S. Duncan, Jr.; Furbish, William J.** Directory of geological research in the southeast: Southeastern Geology Spec. Pub. 3, 104 p., 1971.

The publication includes 25 pages of subject index, and over 700 projects are listed. — ESL

01758 **Clarke, Roy S., Jr.; Jarosewich, Eugene; Nelen, Joseph.** The Lost City, Oklahoma, meteorite — An introduction to its laboratory investigation and comparisons with Příbram and Ucera: Jour. Geophys. Research, v. 76, no. 17, p. 4135-4143, illus., tables, 1971.

The first stone to be recovered from the Lost City, Oklahoma, meteorite shower of January 3, 1970, was a 9.8-kg individual. This aerodynamically shaped individual and later aquired 6.6-kg and 272-gram specimens can be fitted together on the basis of morphology. Mineralogical and chemical investigations were undertaken on the Lost City meteorite as well as the Příbam, Czechoslovakia, fall of April 7, 1959, and the Ucera, Venezuela, fall of January 16, 1970. All three are olivine-bronzite chondrites, type H5 and are similar in composition and mineralogy. The three meteorites can be distinguished on the basis of petrologic characteristics that apparently relate to their shock histories. — *from* Authors' abstract

Clausen, H. B. *See* Dansgaard, W. 08743

Clavier, C. *See* Poupon, A. 01764

Clermont, Kevin. *See* Bonini, William E. 01937

01478 **Coates, Donald R.; Landry, Stuart O.; Lipe, William D.** Mastodon bone age and geomorphic relations in the Susquehanna Valley: Geol. Soc. America Bull., v. 82, no. 7, p. 2005-2009, table, 1971.

Two radiocarbon ages provide a stratigraphic framework for some events in the Susquehanna Valley. A 13,320 ± 200 yr B.P. date on a mastodon pelvic fragment from outwash gravels aids in refining the Valley Heads substage in central New York.

A 1,690 ± 100 yr B.P. date on wood provides an age for the first preserved floodplain deposits. — Authors' abstract

Cobban, W. A. *See* Dane, C. H. 01404

01480 **Coffin, Harold G.** Vertical flotation of horsetails (*Equisetum*) — Geological implications: Geol. Soc. America Bull., v. 82, no. 7, p. 2019-2022, illus., table, 1971.

In experiments to determine the flotation characteristics of fresh horsetails (*Equisetum arvense*) as an aid for interpreting fossil giant horsetails (*Calamites*), 63 percent of 140 *Equisetum arvense* floated vertically or stood erect on the tank bottom before complete saturation. Use of fresh- or saltwater gave no appreciable differences. Duration of vertical stance ranged from a few hours to several days, depending on factors of length and freshness. These results suggest that upright fossilized *Calamites* stems may not be in situ, especially if they are single stems unattached to basal rhizomes and if paleoecological and sedimentary evidence also suggests transport. — Author's abstract

01490 **Colbeck, S. C.; Evans, R. J.** Small-scale strain measurements on a glacier surface: Jour. Glaciology, v. 10, no. 59, p. 237-243, illus., 1971.

Surface deformations in the neighborhood of a crevasse field were measured over short (3 m) gage lengths in order to study flow conditions associated with crevasse formations. The results obtained were unusual in that they were inconsistent with large-scale results found by previous workers. It was concluded that the presence of small-scale surface effects, such as fractures, pot-holes and healed crevasses give rise to small-scale deformation fields with large spatial and temporal variations and that there is a lower limit of gage length below which deformation measurements pertinent to regional flow phenomena cannot be made. This lower limit is apparently an order of magnitude greater than the spacing of features which give rise to localized effects. — Authors' abstract

Cole, Ralph C. *See* Prokopovich, Nikola P. 01972

Cole, Robert E. *See* DuMontelle, Paul B. 01737

Collins, Horace R. *See* Struble, Richard A. 01762

01915 **Collins, Stephen E.** How the Smackover play evolved: Oil and Gas Jour., v. 69, no. 20, p. 224, 226, 228, 230-234, illus., 1971.

Carbonate rocks of Upper Jurassic age, principally in the Smackover Formation, are primary targets for petroleum exploration in an arcuate updip area of the Gulf Coast embayment extending from eastern Texas to northwestern Florida. The Smackover is a sedimentary wedge consisting predominantly of oolitic and mudrock limestone and sucrosic dolomite. Smackover production is associated with structures caused by salt intrusion, basement folding and graben faulting. The interrelation between Smackover carbonates, Buckner anhydrites, and Louann salt tends to fit a particular pattern in areas of Smackover production and this can be used as a guide in prospecting. In general, geophysical data are difficult to interpret and structural and stratigraphic relations are complex, but much more petroleum will be found. — WBC

Colonell, Joseph M. *See* Goldsmith, Victor. 01943

Commeau, Robert F. *See* Duke, Michael B. 01428

01454 **Connor, J. J.; Shacklette, H. T.; Erdman, J. A.** Extraordinary trace-element accumulations in roadside cedars near Centerville, Missouri, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B151-B156, illus., tables, 1971.

Unusually high concentrations of lead, copper, zinc, and cadmium were found in samples of cedar collected on the roadside of State Highway 21-72 about 4 miles

northeast of Centerville, Mo. For 15 samples, geometric mean concentrations for these elements in cedar ash were, in parts per million: Pb, 5800; Cu, 190; Zn, 940; and Cd, 12. The high concentrations are thought to reflect vehicular transport of lead-bearing ores from mine to smelter, rather than mineralized rock at depth. — *from* Authors' abstract

Cook, Earl. *See* Tieh, Thomas T. 01450

08726 **Cooke, Ronald U.** Stone pavements in deserts: Assoc. Am. Geographers Annals, v. 60, no. 3, p. 560-577, illus., table, 1970.

Stone pavements are armored surfaces comprising intricate mosaics of coarse particles, usually one or two stones thick, set on or in fine material. They occur widely in many unvegetated areas and predominantly in hot deserts. Pavement studies in several deserts, and especially in Chile and California, suggest that: deflation may be a relatively unimportant process of pavement formation; running water, and processes causing upward migration of coarse particles through the soil may effect coarse particle concentration at the surface; various superficial disintegration processes may break up coarse particles and increase particle density; and the ways in which pavements are established, their rates of formation, and the relative importance of the different processes, may vary greatly from place to place. — Author's abstract

01935 **Coolbaugh, D. F.** La Caridad, Mexico's newest and largest porphyry copper deposit — An exploration case history: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 133-138, illus., table, 1971.

Successful mine exploration requires sound planning and modern exploration techniques, but it also requires perseverance and the right timing. La Caridad mineral area has been known for over 70 years, but as with many mines, it was not "-discovered" until viewed under new economic conditions and exploration philosophies. Present exploration of La Caridad area began in 1964 and was carried out under a joint Mexican Gorvernment-United Nations Project. Detailed exploration was begun in late 1968. The geology of La Caridad deposits conforms, generally, to the "porphyry copper" deposits of Arizona. However, breccias and pegmatites play a very important part in the emplacement of mineralization. — *from* Author's abstract

Cornwall, H. R. *See* Phillips, C. H. 01494

01925 **Cowie, John Watson.** The Cambrian of the North American arctic regions, *in* Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, p. 325-383, illus., 1971.

The Cambrian geology of the Canadian arctic archipelago, Boothia Peninsula, and northern and eastern Greenland is reviewed. The similarity of the geology of northwestern Greenland and Ellesmere Island is well known; prior to Late Cretaceous time they constituted a single land mass. The Canadian and Greenland Shields are essentially continuous and form a basement complex covered in certain areas with a thin layer of Precambrian and Paleozoic sedimentary rocks which are partly cratonic sediments. The boundary between Precambrian and Cambrian formations is controversial. In this paper the boundary is based on the presence of clearly distinguished Cambrian fauna in the various sections. Correlation of the Cambrian system of this area with that of Spitsbergen and Scotland is discussed. — EH

Cox, Allan V. *See* Butler, Robert F. 01485

02066 **Craig, J. R.; Howe, D. A.; Harris, R. L.; Kullerud, G.; Bryan, W. B.** The Ashmore — A new olivine-bronzite chondrite: Meteoritics, v. 6, no. 1, p. 33-37, illus., 1971.

The Ashmore meteorite was found near Ashmore, Gaines County, Tex., in 1969, at a depth of 18 in. It weighed 55.4 kg, and is an H-5 group chondrite showing brecciation and sparsely distributed chondrules. Mineralogically it consists of a spongework of intergrown silicates and metallic and sulfide phases. Olivine and orthopyroxene con-

stitute 70 to 95 percent of the nonopaque portions. Opaque portions constitute 12 to 17 percent of the meteorite, and are predominantly Fe-Ni alloy and troilite. Worm-like intergrowths of kamacite and taenite occur commonly. A partial chemical analysis is given. Comparison of the Ashmore with samples of other West Texas meteorites shows that it is unrelated to any previous find. The Loop meteorite referred to in the abstract on p. 40 of Abstracts with Programs of the Geol. Soc. of America, 1969, pt. 7, is now known as Ashmore. — ESL

08728 **Cramer, Fritz H.** Distribution of selected Silurian acritarchs: Rev. Española Micropaleontología, no. extraordinario, 203 p., illus., 1970.

Comparison of acanthomorphitic acritarch assemblages from Silurian epicontinental seas on both sides of the Atlantic Ocean reveals several clearly differentiated contemporaneous provinces. Biofacies boundaries are independent of lithologic changes. The palinspastic configuration of the biofacies seems to correspond to the average position of Silurian paleolatitudes. Shifting of biofacies with time as observed along a section from Florida to Lake Erie is the the same direction as that of the Gondwana Pole shift. Thus, acritarch biofacies appear to be determined by climate. The 'impoverished' *N. carminae* association is nearest the Gondwana Pole from 40°-70° long., the *N. carminae* association from 20°40°, then a mixed area containing elements of *N. carminae* and *Do. elongata* associations. Between 10° and 20° the *Do. elongata* biofacies grades into the poorly delineated 'Baltic' biofacies nearer the equator. A sixth association similar to the Baltic was found in the Canadian Arctic. The geographic distribution and stratigraphic range of each species are given. — *from* Author's abstract

Crandell, Dwight R. *See* Birkeland, Peter W. 01631

Cranston, R. E. *See* Buckley, D. E. 02086

01495 **Crawford, A. Raymond.** Continental drift and uncontinental thinking — A reply [to discussion by V. L. Bosazza, 1970, of 1970 paper]: Econ. Geology, v. 66, no. 3, p. 499, 1971.

The paper under discussion was published in ibid., v. 65, no. 1, p. 11-16, 1970; Abs. North American Geology, February 1971.

01755 **Cressy, Philip J., Jr.** Cosmogenic radionuclides in the Lost City and Ucera meteorites: Jour. Geophys. Research, v. 76, no. 17, p. 4972-4075, illus., tables, 1971.

Analysis of a 416-gram slice of the first Lost City fragment in a γ-γ- coincidence counting system, starting about 8 days after fall, yielded the following cosmogenic radioactivities (in dpm per kg): Na-22, 74 ± 2; Al-26, 62 ± 1; Sc-46, 12 ± 1; V-48, 11 ± 1; Cr-51, 71 ± 23; Mn-52, 34 ± 11; Mn-54, 85 ± 4; (Co-56 + Co-58), 14 ± 6; Co-57, 9 ± 1; Co-60, 1.9 ± 0.4. Mean depth of the sample from the preatmospheric surface was < 25 cm, equivalent to a stony mass of less than 200 kg. The radioactivities in Ucera are: Na-22, 60 ± 4; Al-26, 43 ± 3; Sc-46, 9 ± 4; Mn-54, 61 ± 4; Co-60, 5.5 ± 1.6. The Na-22, Al-26, and Mn-54 activities suggest that Ucera, like Harleton, was a small body in space. — DBV

Crice, Douglas. *See* Greensfelder, Roger W. 01819

Crice, Douglas. *See* Greensfelder, Roger W. 01891

01573 **Crickmay, C. H.** The role of the river — A preliminary essay in the physics of surface process: Calgary, Alberta, Evelyn de Mille Books, 30 p., 1971.

Landforms are here classified in 10 categories: flats; smooth slopes; rough slopes; surfaces of glacially-marked character; surfaces of wind-blasted character; surfaces of wind-blown sand; surfaces showing dislocation marks, fault striae, etc.; volcanic surfaces; spring-deposit surfaces; and combination forms. Forms within each category are described briefly. Processes of weathering, wasting, and wind and stream erosion are discussed. Stream erosion is examined in detail, and the role of laterally-

cutting rivers in development of scenery is emphasized. Classes of surficial processes responsible for interfluve reduction are: downcutting, lateral erosion, wave action, slope wasting, solution-wasting of the entire surface, and removal of weathering products by wind, rain, etc., in areas beyond the reach of active wasting. The cycle of denudation is examined. — VSN

01435 **Croft, M. G.** A method of calculating permeability from electric logs, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B265-B269, illus., table, 1971.

A method is described for calculating permeability and transmissivity from resistivity curves of electric logs of water wells. The transmissivity calculated from the logs was reasonably accurate when compared with aquifer tests at two sites. The method should prove useful for construction of transmissivity maps in areas where electric logs of water wells are abundant. — Author's abstract

01609 **Cronin, John R.; Moore, Carleton B.** Amino acid analyses of the Murchison, Murray, and Allende carbonaceous chondrites: Science, v. 172, no. 3990, p. 1327-1329, illus., table, 1971.

Three carbonaceous chondrites were examined for water-extractable amino acids. The Murchison and Murray specimens were found to be of similar amino acid composition. This similarity suggests that these amino acids are indigenous to type II carbonaceous chondrites. The Allende (type III) carbonaceous chondrite was found to be essentially devoid of amino acids on the basis of an identical analysis. — Authors' abstract

01659 **Crouch, S. L.** The post-failure behavior of norite in triaxial compression: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 83-97, illus., 1971.

Results are presented of a comprehensive series of quasi-static triaxial compression tests on a South African norite, at confining stresses up to 8,000 psi. Comparison with previous data for a Witwatersrand quartzite reveals significant differences between the deformational behavior of the two rocks, particularly in the manner in which lateral expansion at maximum axial stresses varies with confining stress. For norite the amount of lateral expansion in excess of that due to linear elastic compression increased steadily about threefold between confining stresses of 50 and 6,000 psi and then remained constant; for quartzite the excess lateral expansion was four times higher at 2,500 psi than at 50 and 5,000 psi. The rate of lateral expansion at maximum axial stress decreases with increased confinement in a similar manner for both rocks, although at any particular confining stress the absolute rate is higher for quartzite. — DBV

01662 **Crouch, S. L.** Anote on post-failure stress-strain path dependence in norite: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 110-122, illus., 1971.

Several experiments were performed to study the influence of the loading path on the post-failure behavior of a South African norite. It was found that the compressive strength of this rock is essentially independent of the manner in which the axial and confining stresses are applied, at least for moderate confinement. Further, the test results indicate that a transition between the axial stress-axial strain and lateral component of volumetric strain-axial strain curves for constant confining stresses can be effected by increasing or decreasing the confining stress. However, when the confining stress is decreased, this transition is controlled by the longitudinal stiffness of the testing system. — Author's abstract

01910 **Cruickshank, Michael J.** Marine minerals and the western Americas: Jour. West, v. 10, no. 1, p. 23-34, 1971.

Many undersea mines in earlier years came to diastrous ends, but there are still reports of riches under the sea, and the eastern Pacific area is in the forefront. Marine

mineral resources fall into three major classes: those derived from ocean waters; unconsolidated deposits on the shelf and slope, and on the deep-sea floor; and deposits in the bedrock underlying the sea. Distribution of these deposits is described. Examples given include: salt and magnesium from sea water, and the methods of producing them; gold in beaches and submarine placers; oyster shell deposits; phosphate concretions and manganese nodules; and petroleum. — ESL

01781 **Crump-Wiesner, Hans J.; Feltz, Herman R.; Purdy, William C.** The determination of vanadium in brines by atomic absorption spectroscopy [with French and German summaries]: Anal. Chim. Acta, v. 55, no. 1, p. 29-36, illus., tables, 1971.

A standard addition method is described for determination of vanadium in brines by atomic absorption spectroscopy with a nitrous oxide-acetylene flame. Sample pH is adjusted to 1.0 with concentrated hydrochloric acid and vanadium is directly extracted with 5 percent cupferron in methyl isobutyl ketone (MIBK). The ketone layer is then aspirated into the flame and recorded absorption values are plotted as a function of concentration of added metal. As little as 2.5 $\mu g\ l^{-1}$ of vanadium can be detected under conditions of the procedure. Tungsten and tin interfere when present in excess of 5 and 10 $\mu g\ ml^{-1}$, respectively. The concentrations of the two interfering ions normally found in brines are well below interference levels. [Tabulated are results of vanadium analyses in brine from Great Salt Lake and several others.] — Authors' summary

Culbertson, J. K. *See* Scott, C. H. 01434

Curray, Joseph R. *See* Swift, Donald J. P. 01551

Dale, M. B. *See* Norris, J. M. 01563

01476 **Dalrymple, G. Brent.** Potassium-argon ages from the Pololu Volcanic Series, Kohala Volcano, Hawaii: Geol. Soc. America Bull., v. 82, no. 7, p. 1997-1999, table, 1971.

Potassium-argon ages on five lava flows from the Pololu Volcanic Series, thought to be among the oldest rocks exposed on the island of Hawaii, indicate that the main subaerial shield-building phase of Kohala Volcano occurred about 0.7 ± 0.15 m.y. ago and that most of the island was formed within the past 0.7 m.y. — Author's abstract

01499 **Damberger, Heinz H.** Coalification pattern of the Illinois Basin: Econ. Geology, v. 66, no. 3, p. 488-494, illus., 1971.

Illinois coals range from high volatile C to A bituminous rank; rank increases gradually from NW to SE in the Illinois basin. In the north and central basin, iso-rank lines for the Herrin (No. 6) coal member of the Carbondale Formation exhibit increase in rank with depth and parallel structural contour lines fairly closely. In southern Illinois, however, rank continues to increase southeastward, although coals become shallower and finally crop out on the southern edge of the basin. Continued southward increase in rank was probably caused by southwardly increasing depth of burial of coals during coalification and the tectonic closure of the basin after coalification had essentially terminated or by increased heat flow above a possible plutonic intrusion in that part of Illinois. — *from* Author's abstract

08747 **Damon, P. E.** Radiocarbon as an example of the unity of science, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 641-644, 1970.

This article summarizes progress made in the field of C-14 dating. In relation to the three commonly accepted major causes of C-14 fluctuations (heliomagnetic modulation of cosmic-ray flux, changes in the magnetic field, and climatic perturbation of the radiocarbon reservoirs and the exchange rates between reservoirs), Damon reviews the highlights of discoveries revealed at the Twelfth Nobel Symposium. — EH

08764 **Damon, P. E.** Climatic versus magnetic perturbation of the atmospheric C-14 reservoir, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 571-593, illus., tables, 1970.

A Δ C-14 curve for the last seven millennia, as determined by measurements or dendrochronologically dated tree rings, consists of ± 20 per mil fluctuations superimposed on a long-term oscillation of about 9,000 yr and an amplitude of ± 50 per mil. This C-14 oscillation is approximately inverse to the geomagnetic-field oscillation whose amplitude is accounted the major causal factor of the C-14 oscillation. However, the time lag is shorter than that predicted by theory. The geomagnetic perturbation is superimposed on a climatic perturbation of smaller magnitude. The ± 20 per mil fluctuations can be accounted for by heliomagnetic-modulation models, in which sunspot data are used as an index of changes in C-14 production caused by solar wind. The effect of the Δ C-14 curve of the late Quaternary magnetic reversal reported previously cannot be evaluated until this event is dated more precisely. — *from* Author's abstract

02003 **Damon, Paul E.** The relationship between Late Cenozoic volcanism and tectonism and orogenic-epeirogenic periodiocity, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 15-35, illus., tables, 1971.

Statistical treatment of late Mesozoic and Cenozoic magmatic events coupled with analysis of paleogeographic data demonstrates that orogenesis is periodic with a wavelength of 36 ± 11 m.y. Intensities of diastrophism and magmatism can be represented by a Gaussian distribution with a standard deviation of ± 8 m.y. During orogenic pulses, the athenosphere migrates upward into the lithosphere, and the resulting plastic crust allows continental drift to proceed more rapidly. Rate of vertical epeirogenic displacement is determined by rate of continental drift and slope of rises, and may be measured in cm per thousand yr as compared to cm per yr for continental drift. The Late Cenozoic tectonic state of western North America is at one extreme of an epeirogenic cycle; furthermore, the Cascadian orogeny is only in its beginning stages and should become more intense and spread eastward. — *from* Author's summary

01404 **Dane, C. H.; Landis, E. R.; Cobban, W. A.** The Twowells Sandstone Tongue of the Dakota Sandstone and the Tres Hermanos Sandstone as used by Herrick (1900), western New Mexico, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B17-B22, illus., 1971.

The Twowells Sandstone Tongue of the Dakota Sandstone is an extensive unit that joins the undivided beds of the Dakota along a line trending northeast approximately through Window Rock, Ariz. It was deposited in a shallow-water marine shelf environment and over much of its extent contains a molluscan fauna having the same age as the Hartland Shale Member of the Greenhorn Limestone in southeastern Colorado and southwestern Kansas. The underlying Whitewater Arroyo Shale Tongue of the Mancos Shale is the same age as the Lincoln Limestone Member of the Greenhorn. Previous correlations of the Twowells with the Tres Hermanos Sandstone as named by Herrick (1900) have been in error; the Tres Hermanos at its type locality is a stratigraphically higher and younger sandstone of early Carlile age. — Authors' abstract

08743 **Dansgaard, W.; Johnsen, S. J.; Clausen, H. B.; Langway, C. C., Jr.** Ice cores and paleoclimatology, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 337-348, discussion, p. 348-351, illus., table, 1970.

Oxygen-isotope measurements (δ) on continuous ice core drilled through the entire ice sheet at Camp Century, Greenland, have revealed a climatic record, probably spanning more than 100,000 years. Estimates of ice age were obtained by considering the ice-flow pattern under simple assumptions. The oxygen-isotope data provide far greater and more direct climatologic detail than any hitherto applied method.

Spectral analysis of data show climatic oscillations with periods of approximately 400 and 2,400 yr on the adopted time-scale, probably reflecting solar-activity variations. The independently calculated time-scale agrees essentially with the C-14 scale, judging from δ-variations left by late-glacial climatic events. Beyond the range of C-14 dating, the δ-record suggests agreement with high-sea stands dated by Th-230 and Pa-231. — *from* Authors' abstract

Dasch, E. Julius. *See* Reynolds, Peter H. 01533

01542 **Dasch, E. Julius; Biscaye, Pierre E.** Isotopic composition of strontium in Cretaceous-to-Recent pelagic foraminifera: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 201-204, illus., table, 1971.

Variations in the strontium isotopic composition of Cretaceous-to-Recent pelagic foraminifera show that the Sr-87/Sr-86 ratio for open ocean water has increased from about 0.7075 to about 0.7092 since Cretaceous time. These values agree, within analytical uncertainties, with those determined by Peterman et al (1970) on epicontinental carbonate fossils. — Authors' abstract

Davidson, Donald M. *See* Hinze, William J. 01825

01801 **Davidson, Donald M., Jr.** A new view of the Duluth Complex, Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 13-14, table, 1971.

01855 **Davies, David K.; Ethridge, Frank G.; Berg, Robert R.** Recognition of barrier environments: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 4, p. 550-565, illus., tables, 1971.

The vertical succession of sedimentary structures and textures in the Holocene Galveston Barrier Island, Texas, is the same in a Lower Cretaceous barrier complex in Montana, and in a Lower Jurassic barrier in England. A general model of barrier sedimentation was developed from these similarities. Plots of environmentally sensitive textural and compositional parameters, established by analyses of quartz size and content, demonstrate that different environments can be distinguished by thin section study. Full diameter cores may not be necessary in some cases, as reliable environmental interpretations may be made from thin sections of sidewall cores in barrier sandstones. — BHK

01460 **Davis, Gregory A.; Burchfiel, B. C.** Tectonic style, magnitude, and age of deformation in the Sevier orogenic belt in southern Nevada and eastern California — Discussion [of paper by R. J. Fleck, 1970]: Geol. Soc. America Bull., v. 82, no. 5, p. 1433-1435, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 6, p. 1705-1720, 1970; Abs. North American Geology, January 1971.

Davis, Raymond, Jr. *See* Forman, Miriam A. 01877

Davis, William J. *See* Yorke, Thomas H. 01452

Dawson, C. E. *See* Abbott, Walter. 01814

01626 **deBretizel, P.; Foglierini, F.** Les gîtes sulfurés concordants dans l'environment volcanique et volcano-sédimentaire [Concordant sulfide deposits in volcanic and volcano-sedimentary environments (with English abstract)]: Mineralium Deposita, v. 6, no. 1, p. 65-76, illus., table, 1971.

The problem set by conformable sulfide concentrations in paleovolcanic environments does not give very satisfactory results if only structural controls or hypothetic action of mineralizing fluids subsequent to volcanism are studied. Research into the geological evolution of volcanic systems and into fumarolian activity which accompanies eruptive phases appears to be more fruitful in helping to interpret formation

and accumulation of metallic sulfides. By concise analysis of certain metalliferous volcanic formations, in the Canadian Shield, the Appalachians, and the Tasman geosyncline (Australia), one can define a volcanic and volcano-sedimentary frame as being comparable to current systems. Observations in Vulcano Island [off Sicily] on sulfides produced by an active fumarole field suggest a genetic hypothesis applicable to fossil deposits, which can be inserted in this volcano-sedimentary frame. — *from* Authors' abstract

Deck, Bruce L. *See* Bubeck, Robert C. 01487

01498 **DeGeoffroy, J.; Wignall, T. K.** A probabilistic appraisal of mineral resources in a portion of the Grenville province of the Canadian Shield: Econ. Geology, v. 66, no. 3, p. 466-479, illus., tables, 1971.

A probabilistic method of appraisal of mineral resources is applied to a 17,000 sq mi portion of the Grenville Province of the Canadian Shield. Regression and Bayesian classification models are formulated from geologic data obtained in well prospected 100 sq mi cells including known commercial deposits. These models provide predictions of ore values and probabilities of success for the cells of the study area. The expected dollar payoff is used to rate exploration potential of these cells. As a result of application of this procedure, eleven cells with a total predicted ore value of 425 million dollars are selected for exploration by airborne and ground reconnaissance surveys. — Authors' abstract

Delach, M. N. *See* Horn, D. R. 01924

01964 **Desautels, Paul E.** Gemstones — The royal line, excerpted from Chap. 3, *of* The mineral kingdom, by the author: Mineral Digest, v. 1, p. 78-93, illus. [1971,].

Gemstones are set apart from other minerals by their beauty, rareness, and durability. Characteristics that determine quality and value of a gemstone are: hardness, weight, specific gravity, index of refraction, dispersion, and chatoyancy. Individual gems discussed and described are: diamond, ruby and sapphire, emerald, pearl, jade, opal, chrysoberyl, garnet, peridot, quartz, sphene, topaz, tourmaline, and zircon. A review of the lapidary arts concludes the paper, and 11 color photographs illustrate it. — ESL

Desbrandes, Robert. *See* Gabillard, Robert L. A. 02036

Dewey, John F. *See* Bird, John M. 01566

01731 **Dickinson, William R.** Plate tectonic models for orogeny at continental margins: Nature, v. 232, no. 5305, p. 41-43, illus., 1971.

Several models, each consistent with plate tectonic logic, can be invoked to explain the eventual orogenic deformation of miogeoclinal continental margins. The two principal alternatives are these: the inactive continental margin on which the miogeoclinal assemblage accumulates may be activated as the consuming or overriding plate margin of a newly initiated arc-trench system; or the quiet continental margin with its geoclinal wedge of strata may ride against an arc-trench system at a convergent plate juncture through consumption of the intervening oceanic crust forming the basin offshore from the miogeoclinal wedge. The orogenic consequences of each model are examined, and arguments that can be used to sort out pertinent orogenic events in space and time are given. There is a real possibility of confusion between the two models. — DBV

01998 **Dietrich, Richard V.** Quartz — Two new blues: Mineralog. Rec., v. 2, no. 2, p. 79-82, illus., table, 1971.

Most, perhaps all, blue quartz appears blue in reflected light only. The blue appearance has been found to depend upon the scattering of light rays by colloid-size inclusions of minerals — rutile, magnetite, or tourmaline and possibly apatite and ilmenite — or by trains of similar sized bubbles. Quartz from a gneiss in the Blue Ridge

of southwestern Virginia is thought to appear blue in reflected light because of closely spaced micro-fractures and/or inclusions of colloid-size crystallites of zoisite within the quartz. — Author's abstract

Dietz, Robert S. *See* Freeland, George L. 01735

Dilcher, D. L. *See* Sheffy, M. V. 01504

Dill, Charles E., Jr. *See* Swift, Donald J. P. 01672

Diment, William H. *See* Bubeck, Robert C. 01487

01802 **Dimroth, Erich; Chauvel, Jean-Jacques.** Textural facies analysis of Precambrian cherty ironstones [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 15-17, 1971.

Dingler, John R. *See* Southard, John B. 01673

Dinkins, Theo H., Jr. *See* Baughman, Wilbur T. 01769

Dinnin, J. I. *See* Greenland, L. Paul. 01420

08737 **Dixon, Mark A.** Basement structures in and under Gulf Coast salt masses [summ.], *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 67-71, with discussion, 1970.

The notes published here reflect the author's ideas at the time he was a graduate student at Louisiana State University. Isostatic compensation below large growing salt masses may possibly create and maintain large structures in the basement rocks. Theoretical models, based on the Marchand-Timbalier-Caillou massif (Atwater and Foreman, 1959) indicate basement relief of 20,000-30,000 feet within and under the salt. — GDC

Doan, Arthur S., Jr. *See* Nava, David F. 01754

01639 **Dodd, R. T.** Chondrites, *in* Planetology, U.S. National Report, 1967-71, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 7, p. IUGG 447-453, 1971.

This is a review and bibliography of American contributions in the field of chondrites, published in 1967-70. An attempt is made to summarize out present understanding of several problems posed by the chondrites: classification; metamorphism, chondrite-achondrite relationships, origin, and organic compounds in chondrites. The bibliography is about three and one-half pages long. — DBV

01640 **Dohnanyi, Julius S.** Micrometeoroids, *in* Planetology, U.S. National Report, 1967-71, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 7, p. IUGG 459-464, 1971.

This review covers satellite measurements of micrometeoroid flux, particle collection experiments, and theories of the origin of micrometeoroids. A bibliography of 3 + pages is given. — DBV

01859 **Dole, Hollis M.** Remarks on United States mineral economy: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 782-785, 1971.

The growing public demand for cleaner environment cannot be met with current techniques of recovering, processing, and using minerals; nor can the growing demand for materials and energy be met with past technology. Between now and the year 2000, demands for iron, aluminum, copper, phosphorus, and petroleum are expected to increase from two to eight times, and many technologic changes will be required. The traditional concept of "national mineral self-sufficiency" no longer assures adequate low-cost mineral supplies. We must look at mineral distribution on a global scale, and stress the use of low-cost water transportation. In consumption, we

must shift emphasis from specific *commodities* to *materials*, and begin to design properties rather than just select them. More sophisticated technology will increase the use of more abundant elements, such as aluminum, sodium, and silicon, as less abundant minerals become more expensive to find and recover. — BHK

01565 **Donahue, Jack.** Burrow morphologies in north-central Pacific sediments: Marine Geology, v. 11, no. 1, p. M1-M7, illus., 1971.

An examination of split core photographs, in a north-south series from southwest of the Marshall Islands to within Bering Sea, reveals three different burrow morphologies. Showing a gradual increase in size toward the equator, Simple burrows are ubiquitous over the region of study, and Halo burrows are present in water deeper than 4,000 m (3,000 m along the equator) and removed from continental areas; Imbricate burrows, larger and relatively rare, have an irregular distribution. The vertical core sequences are generally Pleistocene in age, but some cores may extend into Pliocene and Miocene sediments. To determine any relation between them and burrow morphologies, sediment types were tabulated. Organisms responsible for burrows are interpreted as surface to near-surface feeders which do not penetrate deeply into sediments. Thus the zone of sediment mixing caused by burrowing ranges from 10 to 30 cm and averages 20 cm. — GDC

01552 **Donath, Fred A.; Fruth, Lester S., Jr.** Dependence of strain-rate effects on deformation mechanism and rock type: Jour. Geology, v. 79, no. 3, p. 347-371, illus., tables, 1971.

Results of 69 triaxial compression tests on marble, lithographic limestone, fine-grained sandstone, and siltstone indicate that effects of rate of deformation on strength and deformation behavior of rock depend upon deformation mechanisms which, in turn, depend upon rock type and environmental conditions. For rocks deforming by intracrystalline gliding or by recrystallization, effects of large changes in strain rate can be significant; for rocks deforming by cataclastic flow there is no significant effect of strain rate. In rocks sustaining differential stress over long periods of time, mean pressure at a given depth can exceed by a significant amount the calculated over-burden pressure, and shear stress would be present. The magnitude of the differential stress that could exist would depend on strength of the rocks at the confining pressure, pore pressure, and temperature in the particular environment. — VSN

Donn, William L. *See* Shaw, David M. 01630

01927 **Douglas, J. A. V.** Revised catalogue of the National Meteorite Collection of Canada listing acquisitions to August 31, 1970: Canada Geol. Survey Paper 70-66, 41 p., 1971.

A catalog of the National Meteorite Collection of Canada, published in 1963 listed 242 different meteorite specimens. Since then specimens from 50 additional meteorites have been added to the collection and several more specimens have been added to the tektite collection. This report describes all specimens in the collection. — Author's abstract

01647 **Douglas, Lowell A.; Flessinger, Francois.** Degradation of clay minerals by H_2O_2 treatments to oxidize organic matter: Clays and Clay Minerals, v. 19, no. 1, p. 67-68, illus., table, 1971.

Soil and sediment samples are usually treated to remove organic matter prior to clay mineral investigations. Addition of H_2O_2 to a soil may cause the pH of the soil-water-H_2O_2 slurry to become quite acid. Experimenting with three 2:1 clays, when H_2O_2 was added to one free of organic matter, the pH change was negligible; H_2O_2 plus sucrose treatment caused X-ray diffraction (001) intensities of H-31 and Fisher bentonite to reduce to about 1/3, and of Libby vermiculite to about 1/10 of intensities of untreated diffraction lines. When a 1 N sodium acetate buffer was added to these soils, then H_2O_2, the pH of all samples rose from 6.9 to 8.0. X-ray examination of those clays in which sucrose had been oxidized in a sodium acetate buffered slurry

revealed little degradation of the clays. Diffraction patterns were intermediate between the untreated (top) and H_2O_2 treated (middle) patterns figured. — GDC

02019 **Downey, Joe S.** Ground-water basic data, Nelson and Walsh Counties, North Dakota: North Dakota Geol. Survey Bull. 57, pt. 2 (North Dakota Water Comm. County Ground-Water Studies 17, pt. 2), 459 p., illus., tables, 1971.

The basic ground-water data on Nelson and Walsh Counties, North Dakota, collected between 1967 and 1970, consist of data for about 2,150 wells and test holes, water-level measurements in 83 observation wells, logs of about 600 test holes and wells, chemical analyses of about 300 water samples, and particle-size analyses of material from various aquifers. — EH

01674 **Drake, Ellen T.** Dangers of working with anisole in falling-drop grain-size analysis: Sedimentology, v. 16, no. 3-4, p. 265-266, 1971.

Anisole fumes are toxic, as symptoms experienced by this author indicate. Prolonged inhalation may lead to poisoning with chronic effects, which are significant since benzene, the parent of anisole, is a known bone marrow depressant. Extreme caution is recommended in any use of this compound, whose properties are ideal for use in the falling-drop apparatus for grain-size analysis of fine-grained sediment. This apparatus using anisole must be operated under a fume hood. — GDC

Dratler, Jay, Jr. *See* Block, Barry. 01744

01611 **Drever, James I.** Magnesium-iron replacement in clay minerals in anoxic marine sediments: Science, v. 172, no. 3990, p. 1334-1336, illus., 1971.

In anoxic marine sediments iron is extracted from clay minerals to form a sulfide. Magnesium from the surrounding solution than replaces the extracted iron in the clay mineral structure. This process removes magnesium from seawater and serves as a control on the composition of interstitial waters in sediments. — Author's abstract

Duane, D. B. *See* Brashear, H. R. 02001

01945 **Duane, David B.** Synoptic observations of sand movement, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 799-813, illus. [1971].

A multi-agency program to create a viable radioisotopic sand tracing (RIST) system was initiated. Data obtained with the system can be considered as nearly synoptic observations of sediment transport in a single environmental zone or in adjacent beach, surf, and offshore zones. Using sand tagged with isotopes of gold experiments were carried out at several sites on the California coast. Data from the studies in beach areas unmodified by littoral barriers indicate that under a given set of wave conditions, the alongshore velocity of sediment transport differs from zone to zone such that transport seaward of peaking-breaking waves < transport on the beach face < transport in the plunge and surf zone. Because of these differences, tracing surveys confined solely to foreshore or offshore zones produce data only partially indicative of transport in the zone of immediate concern to coastal engineers. — *from* Author's abstract

Duda, Seweryn J. *See* Bahjat, Dhari S. 01999

Duennebier, Frederick K. *See* Northrop, John. 01651

01803 **Duhling, William H., Jr.** Precambrian iron formation at Copper Mountain, Fremont County, Wyoming [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 18-19, 1971.

01428 **Duke, Michael B.; Commeau, Robert F.** A clean laboratory for mineralogical and geochemical studies, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B207-B210, illus., table, 1971.

A class-100 (less than 100 particles per cubic foot of air) laminar-flow clean room has been built for mineralogical analyses that must exclude atmospheric particulate contamination. The room is kept clean in two basic ways: (1) air is continuously recycled through high-efficiency particulate air filters, and (2) laminar airflow is maintained so that particles do not settle on material being worked on. The laboratory is used for special problems such as mineralogical studies of lunar soil. — *from* Authors' abstract

Dumanoir, J. *See* Poupon, A. 01764

01737 **DuMontelle, Paul B.; Hester, Norman C.; Cole, Robert E.** Landslides along the Illinois River valley south and west of La Salle and Peru, Illinois: Illinois Geol. Survey Environmental Geology Notes 48, 16 p., illus., 1971.

Instability of slopes along the Illinois River bluffs in the La Salle-Peru region of Illinois is due to the fact that the slopes consist of a particular type of clay-rich shale, the Bond Formation, that they are generally steeper than 20°, and that periods of heavy rainfall are typical of the area. Abnormally high amounts of rainfall help to erode the toe of slopes, increase bearing weight on the underlying formations, and lubricate the materials in the slope, causing them to flow or fracture. Analysis of shale samples of the Bond Formation show that approximately 50 percent of unweathered shale consists of clay-size particles, whereas weathered shale contains more than 70 percent of these particles. Uusually more than 50 percent of the clay in the samples consists of the expandable type of clay minerals. The weathered shales are more prone to sliding and slumping than the unweathered shales. — Authors' abstract

Duncan A. R. *See* Taylor, S. R. 02081

01483 **Dunn, J. R.; Fuller, M.; Ito, H.; Schmidt, V. A.** Paleomagnetic study of a reversal of the Earth's magnetic field: Science, v. 172, no. 3985, p. 840-845, illus., 1971.

A detailed record of a reverse-to-normal field reversal which occurred 14.7 ± 1 m.y. ago has been obtained from the natural remanent magnetization of the Tatoosh intrusion in Mount Rainier National Park, Wash. A decrease in intensity of about an order of magnitude occurs immediately before reversal, while its orientation remains substantially unchanged. The onset of reversal is marked by abrupt swinging of the virtual geomagnetic pole along an arc of a great circle. During reversal the pole traces a path across the Pacific. In the last stage, the succession of virtual geomagnetic poles is very similar to those generated by secular variation in the recent past. An estimate of the duration of the reversal process gives 1 to 4×10^3 yr for the reversal of field direction and approximately 1 to 10^4 yr for the time scale of the intensity changes. — DBV

01813 **Durum, Walton H.** Chemical, physical, and biological characteristics of water resources, Chap. 1 *in* Water and water pollution handbook, V. 1 (Leonard L. Ciaccio, editor): New York, Marcel Dekker, Inc., p. 1-49, illus., tables, 1971.

Chemical, biological and physical factors which influence water quality, and temperature which influences these factors are discussed. Inorganic, organic and biological parameters define the basic data necessary for a water quality data program. These data must be considered within the framework of their instantaneous characteristics, characteristics for a given time interval, and patterns of fluctuation. Water quality modeling is briefly discussed. — EH

Dutro, J. Thomas, Jr. *See* Armstrong, A. K. 01405

01412 **Dutton, Carl E.** Volcanic-sedimentary belts and sulfide occurrences in Wisconsin, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B96-B100, illus., 1971.

Several areas in Wisconsin have exposures of Precambrian volcanic-sedimentary sequences similar to the Archean greenstone belts from which important amounts of copper, lead, zinc, gold, and silver are obtained in Ontario and Quebec. Areas of

principal interest in Wisconsin total about 1600 sq mi; sparse data from scattered outcrops and explorations for iron ore, and from magnetic surveys, suggest that additional areas, which total about 1000 sq mi, are underlain by similar sequences. The amount of exposed bedrock in the areas ranges widely and is generally so sparse that geophysical surveys must supplement geologic mapping in order to plan explorations for potential mineral deposits. — *from* Author's abstract

01911 **Duxbury, Alyn C.** The earth and its oceans: Reading, Mass., Menlo Park, Calif., and London, Addison-Wesley Publishing Co., 381 p., illus., tables, 1971.

The approach used is that of an overview of the oceans as an environment that is affected by what the earth does, is, and its setting in the solar system. The text is divided into 18 chapters entitled: geodesy of the Earth and Earth's structure; Earth in motion; the hydrosphere, its distribution and transfer processes; ocean basins and borderlands; sediments of the deep sea; chemistry of sea water; physical properties of sea water; transmission of sound and light; consequences of physical and chemical properties of sea water; heat budget; Earth's atmosphere and its circulation; circulation of the oceans; marginal semi-enclosed seas and basins; marine biological environment; biological population of the oceans — benthos, plankton, and nekton; waves; tides; and oceanographic instruments and their uses. — ESL

08769 **Dvoracek, Marvin J.; Peterson, Sam H.** Recharging the Ogallala Formation using shallow holes, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 205-218, illus., table, 1970.

In the past year more than 15 acre-feet of runoff water was recharged through a shallow hole. The rate of recharge showed a steady increase rather than the expected decline. Since redrilling the second hole, an even more unexpected phenomenon was observed: when recharge started, the water in both holes rose together, with the level in the second lower than in the first, and with constant recharge rate the two water levels stabilized at different levels. The difference in head seemed to correspond to rate of recharge. This method proved to be an effective means of artificially recharging the Ogallala Formation in the test area (on the Texas Tech. Farm). — DBV

01948 **Dyhr-Nielsen, M.; Sörensen, Torben.** Some sand transport phenomena on coasts with bars, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 855-865, illus. [1971].

This paper presents examples of the influence of relatively weak, transverse or secondary currents on processes in the shore zone. An analogous effect of secondary currents in alluvial streams gives rise to meandering. Conclusions are based on simple, qualitative considerations of the physics of the system. Effects of secondary currents on sediment transport are discussed, particularly a "meander" pattern observed on the shoreline and on the outer bar. — EH

01425 **Dyni, John R.; Mountjoy, Wayne; Hauff, P. L.; Blackmon, Paul D.** Thermal method for quantitative determination of nahcolite in Colorado oil shale, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B194-B198, illus., tables, 1971.

When nahcolite-bearing oil shale is heated at 105°C for 14 hours, nahcolite decomposes to sodium carbonate by loss of carbon dioxide and water. The amount of nahcolite can be calculated from this weight loss by the following equation: Nahcolite (weight percent) = percent weight loss × 2.690 + 0.375. The statistical accuracy of the method compared to that of chemical analyses is ± 2 weight percent at 95-percent confidence limits. The method is reasonably free of interferences and requires a minimum of laboratory equipment. Trona can also be determined by the thermal method. The technique cannot be used to determine the amount of dawsonite in oil shale because the higher temperatures required to decompose dawsonite also decompose associated kerogen. — *from* Authors' abstract

01612 **Dziewonski, Adam M.** Overtones of free oscillations and the structure of the Earth's interior: Science, v. 172, no. 3990, p. 1336-1338, illus., table, 1971.

Identification of 82 percent of all possible spheroidal overtones with periods greater than 300 seconds increases the resolving power of the set of gross earth data. Results of inversion indicate a change of composition in the deepest 500 kilometers of the mantle. The assumption that the inner core is rigid is required to satisfy simultaneously the data on free oscillations and traveltimes. — Author's abstract

01523 **Eade, K. E.** Geology of Ennadai Lake map-area (65C), District of Keewatin: Canada Geol. Survey Paper 70-45, 19 p., illus., geol. map, 1971.

This area [Map 24-1970], in the southwest corner of the District of Keewatin, lies entirely within the Churchill Structural Province; drift is heavy throughout. The Hurwitz Group of Aphebian age, comprising orthoquartzite, argillite, greywacke, carbonates, arkose, and minor volcanics, underlies two broad northeast-trending bands. Conglomerate and greywacke unconformably overlie the Hurwitz Group; metavolcanics, paragneiss, granodiorite-gneiss and granodiorite of Archean(,) age underlie it. In the southeast, paragneiss and meta-arkose, possibly correlative with the Hurwitz Group, may lie within the northeast extension of the 'Wollaston Lake fold belt.' Postorogenic (Hudsonian) plutons of quartz monzonite and coarse-grained, porphyritic, fluorite-bearing granite are the youngest exposed rocks. Folds, in both the sedimentary and older rocks, generally trend northeast; all rocks are extensively faulted. No significant mineralization was discovered. — *from* Author's abstract

08738 **Eargle, D. Hoye; Herbst, Emmett L.** Regional geology and the Salmon event, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 87-107, illus., 1970.

The explosion of a tamped nuclear device in the salt stock of Tatum dome, Lamar County, Mississippi, in October 1964, produced geological and geophysical information of regional and worldwide significance regarding transmission of seismic waves. Preshot and postshot studies of southern Mississippi and adjacent Washington Parish, La., in connection with and resulting from this Salmon event, show the geologic structure of part of the Mississippi salt basin. How the transmission of seismic waves was conditioned by rock character and structure, especially by the presence of other domes in the vicinity of Tatum, was brought out by studies of damage to buildings in the more populated parts of the dome area. The buildings were, therefore, used as crude instruments to record the distribution of seismic effects. — *from* Authors' abstract

01916 **Ecker, George D., Jr.** Are there more Peoria fields in DJ?: Oil and Gas Jour., v. 69, no. 28, p. 140-144, illus., 1971.

Peoria field, located in the south-central Denver basin, Arapahoe County, Colorado, produces oil from "J" sands of Early Cretaceous age. Subsurface investigations have demonstrated that these sands were deposited in channels associated with a northeastward building delta complex. Pay thickness ranges from 5 to 46 feet and porosity up to 19 percent. Peoria is second only to Rangely field in daily production rate in Colorado. — WBC

01866 **Edgar, N. Terence; Ewing, John I.; Hennion, John.** Seismic refraction and reflection in Caribbean Sea: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 833-870, illus., table, 1971.

Thirty seismic refraction profiles in the Caribbean Sea demonstrate that: Nicaragua Rise and Beata Ridge have a 5.4 kmps layer over a 6.7 kmps layer; the upper crustal layer (only one recorded) beneath Aves Swell has a velocity of 6.0 kmps; Curaçao Ridge overlies a sediment-filled trough with up to 14.5 km of sediments and rock; and the Netherlands West Indies are underlain by material with velocity of about 5.5 kmps. The reflection profiler shows two acoustically transparent beds in Venezuela and Colombia Basins separated by a strong reflector representing the Mesozoic-Cenozoic boundary, with underlying layer suggestive of a sedimentary horizon. The Caribbean is postulated to be a relict of Mesozoic Pacific crust emplaced between North and South America during separation from Europe and Africa. Interaction of this plate with surrounding lands resulted in geosyncline formation. The Caribbean plate has subsequently decoupled from the Pacific spreading system. — VSN

Edwards, William H. *See* Makovsky, Leo E. 01685

01564 **Eggert, Donald A.; Taylor, Thomas N.** *Telangiopsis* gen. nov., an Upper Mississippian pollen organ from Arkansas: Bot. Gaz., v. 132, no. 1, p. 30-37, illus., 1971.

Telangiopsis arkansanum, n.sp., occurs as compressions in a fine-grained shale unit of the Wedington Sandstone (Chester Seires) near Lincoln, Washington County, Ark. Synangiate pollen organs are borne terminally on a monopodially branched system of slender axes; individual synangia contain five or six sporangia, measure approximately 1.0 mm long and 0.8 mm wide, and contain radial trilete spores 47-54 μ diam. It is type species of a new form genus, *Telangiopsis*, here proposed to include all nonpetrifaction specimens (compressions, casts, molds, etc.) that previously would have been assigned to the genus *Telangium*. Eight previously described species of *Telangium*, and additional forms without specific names, are here transferred to *Telangiopsis; Telangium* is retained for the petrified species *T. scotti* and *T. pigmaeum*. — VMJ

01458 **El-Ashry, M. T.** Trace elements in Pennsylvanian shales in relation to environmental health in northeastern Pennsylvania: Geol. Soc. America Bull., v. 82, no. 5, p. 1425-1428, illus., table, 1971.

Thirty shale samples from Wyoming-Lackawanna Valley in northeast Pennsylvania, overlying and underlying Pennsylvanian coal beds, were chemically analyzed for trace elements Cr, Ni, and Co, known to have a carcinogenic effect on human lungs. Several cases of lung cancer were reported among miners in the northern field of the Anthracite Region, and the cause was attributed to radioactive minerals in coal and rock dust. This study shows the rock formations in the area to have negligible amounts of radioactive material and relatively high concentrations of trace elements. The pattern of relative concentration of trace elements agrees quite well with number of lung cancer cases reported from the different regions; the highest is in the southern part of the valley. It is suggested that lung cancer cases reported among coal miners could be attributed to long exposure to rock dust with high concentrations of trace elements. — *from* Author's abstract

01482 **El-Ashry, M. T.** Causes of recent increased erosion along United States shorelines: Geol. Soc. America Bull., v. 82, no. 7, p. 2033-2037, illus., table, 1971.

The presence of beach ridges extending parallel to the present shorelines of many areas along U.S. coasts indicates progradation of these areas after the last glacial stage of the Pleistocene epoch. The general trend of shoreline changes in the past 100 yrs, however, was erosion of several hundred feet of the beaches. Three major causes are considered responsible for such increased erosion. These are: (1) hurricanes and severe storms; (2) recent eustatic rise in sea level; and (3) interference by man with natural shore processes. — Author's abstract

01571 **Ellison, Samuel P., Jr.** Sulfur in Texas: Texas Univ. Bur. Econ. Geology Handbook, no. 2, 48 p., illus., tables, 1971.

This handbook reviews briefly the history of native sulfur mining; uses, properties, mining and recovery methods, and geology of native sulfur; and the occurrence, economics of Frasch mining, pollution control, and conservation of native sulfur in Texas. Texas occurrences are mainly in subsurface Permian deposits in West Texas and in association with salt domes on the Gulf Coastal Plain. Superheated hot water, steam and compressed air (Frasch method) is used to recover elemental sulfur from deep wells drilled into cap rock. Production data are tabulated. — VSN

01788 **Elnaggar, Hameed; Karadi, Gabor; Krizek, Raymond J.** Effect of non-Darcian behavior on the characteristics of transient flow: Jour. Hydrology, v. 13, no. 2, p. 127-138, illus., 1971.

A modified form of the boundary value problem describing the one-dimensional transient flow in clay soils is formulated to include a non-Darcian flow law with a threshold gradient. The solution is obtained by matrix techniques, and calculated results are compared with results obtained from conventional one-dimensional theory. — Authors' abstract

Emeleus, C. H. *See* Andrews, J. R. 01869

01773 **Emerson, John W.** Channelization — A case study: Science, v. 173, no. 3994, p. 325-326, illus., table, 1971.

Channelization of the Blackwater River in Johnson County, Missouri, 60 years ago nearly doubled the gradient, which caused an increase in the rate of erosion for the river and its tributaries. Since the present channel is much wider and deeper than it was when newly dredged, there have been bridge repairs and loss of farmland. Downstream reduction in channel capacity due to termination of dredging has caused channel sedimentation and increased flooding. — Author's abstract

Emery, K. O. *See* Uchupi, Elazar. 01795

02004 **Emiliani, Cesare.** The amplitude of Pleistocene climatic cycles at low latitudes and the isotopic composition of glacial ice, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 183-197, illus., tables, 1971.

A detailed analysis of the paleontological evidence both on land and at sea shows that the amplitude of the glacial/interglacial temperature range was 7-8°C in the Caribbean, 5-6°C in the equatorial Atlantic, and 3-4°C in the equatorial Pacific. These values and the glacial/interglacial isotopic range of 1.8 per mil measured in the shells of pelagic foraminifera indicate that the average oxygen isotopic composition of sea water during glacial ages was +0.5 per mil and that of glacial ice was -15 per mil. The average oxygen isotopic composition of the North American and European icecaps was about -9 per mil, a value considerably heavier than that assumed by some but in agreement with the expected pattern and isotopic composition of precipitation on these areas during glacial ages. — Author's summary

02080 **Engelke, C. P.; Hilchie, D. W.** A new qualitative permeability indicator, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. M1-M10, illus., 1971.

A new method of detecting invasion (permeability) in low porosity and deep invasion formations is presented. The method is particularly applicable to West Texas type rocks, in which the permeability is primarily due to fracture or large vugs. The system requires the use of salt base or boron treated mud, and a computer plot of the porosity logs and the Neutron Lifetime Log. The system can run in open or cased holes immediately after the drilling of the well. — Authors' abstract

01403 **England, Kenneth J.** Displacement of the Pocahontas Formation by the Russell Fork fault, southwest Virginia, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B13-B16, illus., 1971.

Thickness and lithic variations in Upper Mississippian and Lower Pennsylvanian formations indicate approximately 4 miles of strike-slip movement along the Russell Fork fault. Economically important coal beds of the Pocahontas Formation, currently the objective of deep exploratory drilling, are displaced laterally by this movement. — Author's abstract

Erdman, J. A. *See* Connor, J. J. 01454

Ericson, D. B. *See* Wollin, G. 02088

01712 **Ernst, W. G.** Do mineral parageneses reflect unusually high-pressure conditions of Franciscan metamorphism?: Am. Jour. Sci., v. 270, no. 2, p. 81-108, illus., 1971.

Metasomatic production and metastable recrystallization of observed assemblages are discussed. Petrographic relations indicate that blueschist-type phase associations possessed lower total Gibbs free energies than did the pre-existing ones during Franciscan metamorphism. Generation of observed assemblages by tectonic overpressures, and their production by deep burial are discussed. Only profound burial of the Franciscan followed by substantial postmetamorphic uplift can account for the re-

markable mineralogic differences between the tectonically juxtaposed Franciscan and Great Valley rocks. A dynamic model is presented which shows the proposed relationships among downwarped isotherms if a trench-subduction zone environment is accepted. The Franciscan terrane, now spatially associated with the Great Valley sequence, was metamorphosed in an environment far removed from the present one. — ESL

Ethridge, Frank G. *See* Davies, David K. 01855

Eugster, Hans P. *See* Hardie, Lawrence A. 01785

Evans, C. R. *See* Rogers, M. A. 02061

Evans, R. J. *See* Colbeck, S. C. 01490

01548 **Everett, A. Gordon.** Environmental geology and higher education: Jour. Geol. Education, v. 19, no. 3, p. 137-139, 1971.

The need to broaden the base of education of geology majors in order to make it possible for them to solve problems of our environment is discussed. A study of dynamic geologic processes which include physics, chemistry and biology, is of the greatest importance. — EH

01455 **Everett, K. R.; Hall, G. F.; Wilding, L. P.** Wisconsin age cryoturbation features in central Ohio: Geol. Soc. America Bull., v. 82, no. 5, p. 1407-1410, illus., 1971.

The record of periglacial cryoturbation features in the continental interior is poor, particularly in Ohio. Many such features may be present but are overlooked or misinterpreted because of their small size. In eastern Ohio, small, 15-cm involutions were amplified in a recently made roadcut by the low angle of the cut and accentuated by moisture contrasts between the texturally dissimilar materials of the involutions. The involutions occurred above deeply weathered Illinoian outwash gravels at the contact between pebbly silty materials of Wisconsin age and Wisconsin loess. The small size of the features, the result of a periglacial climate of short duration, was revealed by careful leveling. — Authors' abstract

Ewart, A. *See* Taylor, S. R. 02081

Ewing, John I. *See* Edgar, N. Terence. 01866

Ewing, M. *See* Horn, D. R. 01924

Ewing, M. *See* Wollin, G. 02088

02008 **Ewing, Maurice.** The Late Cenozoic history of the Atlantic basin and its bearing on the cause of the ice ages, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 565-573, illus., 1971.

Geophysical studies and sediment coring programs have provided a picture of the Atlantic Ocean basin during the Cenozoic. It was formed early in the Mesozoic as a rift, and split the Americas from Europe and Africa as it widened; oldest cores are Jurassic. The discontinuity in sediment thickness on the ridge crest and an extensive chert sequence of Late Cretaceous or early Cenozoic age raise questions which have not yet been answered. Evidence suggest that major glaciation began as early as middle Miocene. The relation of these current ideas to the Ewing-Donn theory of ice ages is discussed. It is concluded that the concept of sea-floor spreading must be at the heart of any discussion of late Cenozoic history of the Atlantic basin; that initial stages of glaciation are synchronous in the northern and southern hemispheres; and that either ice-free or ice-covered conditions of Arctic climate would be stable. — ESL

Fahey, Barry D. *See* Andrews, J. T. 01621

Fahey, Barry D. *See* Ives, Jack D. 01682

Fahrig, W. F. *See* Robertson, W. A. 01850

01990 **Fairbairn, H. W.** Radiometric age of mid-Paleozoic intrusives in the Appalachian-Caledonides mobile belt: Am. Jour. Sci., v. 270, no. 3, p. 203-217, illus., tables, 1971.

A compilation of 60 radiometric ages of intrusives associated with Ordovician, Silurian, and Devonian strata in the Appalachian-Caledonides mobile belt, discloses five culminations of igneous activity. These approximate Early Ordovician, 490 m.y.; Late Ordovician, 450 m.y.; Silurian, 420 m.y.; Early Devonian, 400 m.y.; and Middle Devonian, 360 m.y. Mafic and ultramafic plutons of Early Ordovician age are conspicuous. Magmatism was more or less continuous in the Caledonides through Ordovician, Silurian, and Early Devonian (Caledonian orogeny), whereas in the Appalachians it waned in the Silurian after strong Ordovician activity (Taconian orogeny), then picked up, and continued through Lower and Middle Devonian. The final Middle Devonian phase, confined to the Appalachian end of the belt, was contemporaneous with Acadian orogeny. — *from* Author's abstract

01949 **Fairchild, John C.** Laboratory tests of longshore transport, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 867-889, illus., tables [1971].

Tests were made in CERC's Shore Processes Test Basin with waves approaching the toe of a test beach at a 30°-angle. Beach material was quartz sand with median diameter of 0.22 mm which was molded to a 1 on 10 slope before a test. Long crested waves traveled over the beach, shoaled and were refracted before breaking near the shoreline. Breaking action caused the sand to be transported along the shore in the direction of the longshore component of the wave energy flux. Transport rates of 2-170 cu yds per day were measured, the lower rate within the range of laboratory rates reported by Savage and the higher rate comparable to field rates reported by Watts. Analysis includes correlation of measured rates to longshore wave energy flux, and in some tests, to longshore current. Transport rates are about 3 times the rates indicate by CERC TR-4 design curve for a longshore energy range of 0.016 to 0.760 millions of foot pounds per foot of shore per day. — *from* Author's abstract

Fairhurst, C. *See* Brown, E. T. 01655

Fairhurst, C. *See* Roegiers, J. C. 01660

01696 **Farrington, John W.; Quinn, James G.** Comparison of sampling and extraction techniques for fatty acids in recent sediments: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 735-741, tables, 1971.

Saponification of recent sediment samples was the most efficient of several procedures tested for the extraction of fatty acids. Between 32 and 65 percent of the fatty acids in the sediments analyzed could not be released by organic solvent extraction. This fraction was released by saponification and is thought to be bound fatty acid. The precision of the analysis is an improvement over those previously reported for concentrations of fatty acids in sediments. Relative and absolute abundances of fatty acids from sediments give valid criteria for comparison of depositional environments only when uniform sampling and extraction techniques are employed. — Authors' abstract

01899 **Faye, G. H.; Nickel, E. H.** On the pleochroism of vanadium-bearing zoisite from Tanzania: Canadian Mineralogist, v. 10, pt. 5, p. 812-821, illus., 1971.

A study of the polarized optical absorption spectra of both blue and tan-coloured, vanadium-bearing zoisite specimens from Tanzania, revealed a number of spectral features between 13,400 and 27,000 cm^{-1}. Most of these are attributed to V^{3+} substituting on the Al_3 site of zoisite and are responsible for the dichroic scheme of the blue (heated) variety of zoisite. An additional band at 22,500 cm^{-1}, thought to be due to Ti^{3+}, or V^{4+}, occurs in the yellow-green spectrum of tan zoisite, thus producing a trichroic scheme. — *from* Authors' abstract

01906 **Faye, G. H.** A semi-quantitative microscope technique for measuring the optical absorption spectra of mineral and other powders: Canadian Mineralogist, v. 10, pt. 5, p. 889t895, illus., tables, 1971.

Optical absorption spectra of minerals often reveal valuable information on siting of transition metal cations, their valence states, and aspects of geometry of coordination polyhedra. Techniques of measuring absorption spectra in the near ultraviolet to near infrared region are described. The author combined the mineral-oil mull technique with the microscope technique and found the quality of resulting spectra superior to those from other mull techniques. Potential of this technique for semi-quantitative analysis or comparative measurements is discussed, and the apparatus is described. Applications to comparison of lapis lazuli specimens, and semi-quantitative analysis of nickel-bearing serpentines are included. — ESL

Feisher, Murray. *See* Morgenstein, Maury. 01759

Feltz, Herman R. *See* Crump-Wiesner, Hans J. 01781

01625 **Ferenčic, Ante.** Metallogenic provinces and epochs in southern Central America [with German abstract]: Mineralium Deposits, v. 6, no. 1, p. 77-88, illus., 1971.

In this region the ophiolitic belt along the Pacific is related to the late Mesozoic eugeosynclinal trough; no significant mineralization is known in this rock complex. Copper occurrences in the Azuero Peninsula are associated with the late Cretaceous diorite pluton. During Tertiary time, radial tectonic deformation and basalt-andesite-dacite volcanism took place; the associated gold-silver quartz veins and Cu-, Pb-, Zn-(Ag)-sulfide ores form the largest metallogenic provinces. Porphyry copper mineralization in northern Panama is confined to the late Tertiary intermediate hypabyssal intrusives. Laterite and gold placers are the only exogenic deposits. Relative abundance of copper ores in southern Central America indicates a geochemical specialization of magma in copper and the possible continuation of the circum-Pacific copper belt across Central America. — *from* Author's abstract

08719 **Ferguson, John.** The significance of the kakortokite in the evolution of the Ilímaussaq intrusion, South Greenland: Medd. Grönland, v. 190, no. 1, 193 p., illus., tables, 1970; Grönlands Geol. Undersögelse Bull. 89, 1970.

Mineral variation of feldspars within augite syenites of this intrusion is in mild contrast to grain-size and sympathetic with co-existing augites and olivines; Na-feldspars indicate low-temperature albites. In quantitative analyses on 90 whole rocks, and semi-quantitative on 100 kakortokites and 40 minerals, element ratios vary with height in kakortokite sequence, suggesting upward crystallization. Apparently, original augite syenitic magma differentiated along an undersaturated trend, to hybrid syenite at the innermost roof. Postulated is its conversion to agpaitic magma by added volatiles; downward crystallization, with gravity-settled heavier minerals near floor, into sheeted sodalite foyaite and naujaite, and rhythmic layered kakortokite; and residual mush injected between these into overlying breccia to form lujavrites. Problematic alkali granite appears to predate agpaites and post-date syenites. — GDC

02035 **Fertl, Walter H.; Hammack, Gregory W.** A comparative look at water saturation computations in shaly pay sands, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. R1-R18, illus., 1971.

There are numerous domestic and overseas interpretation techniques available to the log analysts for determining water saturation in shaly pay sands. The theory of these different interpretation methods is briefly outlined and the advantages and limitations are discussed. A comparative study of these various techniques was made using actual field examples with the effect of varying amounts of shaliness. This comparative study illustrates the practical application of these various approaches to the interpretation of shaly pay sands and provides the log analyst with accurate results upon which to make his recommendations. — Authors' abstract

Fidler, Richard E. *See* Norris, Stanley E. 01430

Flessinger, Francois. *See* Douglas, Lowell A. 01647

08707 **Finch, Warren I.; Wright, James C.** Linear features and ground-water distribution in the Ogallala Formation of the southern High Plains, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 49-57, illus., 1970.

The southeast-trending Running Water-White River lineament and the nearly parallel Double Mountain Fork line are believed to reflect a zone of structural weakness that has influenced geologic events since Cretaceous time and perhaps much longer. Control is evident in the pre-Ogallala erosion, localization of Ogallala drainage and sedimentation, location of present drainages and depressions, and distribution of ground water in the Ogallala. Artificial recharge of the Ogallala aquifer through the caliche caprock can best be done along linear drainages and alinements of depressions. — DBV

01757 **Fireman, E. L.; Spannagel, G.** Radial gradient of cosmic rays from the Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4127-4134, illus., tables, 1971.

The radioactivities of Ar-37 and Ar-39 were measured in separated iron phase and in whole-rock samples of Lost City. Average values from the iron and nickel at the time of fall were 11.7 ± 0.9 and 24.6 ± 0.9 dpm per kg, respectively, with an Ar-37/Ar-39 ratio of 0.4 ± 0.04. As the orbit of Lost City is known, the low Ar-37/Ar-39 ratio can be interpreted in terms of variation in cosmic ray flux along its orbit. In the whole rock the T and Ar radioactivities were measured as a function of depth along a 10.0-cm bar. The T varied from 260 ± 10 to 358 ± 5 dpm per kg. The T activities, together with low Co-60 activity, indicate that 4 to 11 cm of material was ablated from one end of the bar and 10 to 23 cm from the other. — DBV

01618 **Fisher, David A.; Jones, Stephen J.** The possible future behaviour of Berendon Glacier, Canada — A further study [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 85-92, illus., tables, 1971.

Untersteiner and Nye (1968) calculated the possible future movement of Berendon Glacier, [in the Coast Mts. of] British Columbia. These calculations are repeated using much improved data and a slightly different method for computing the datum state. The predictions that result are very similar to those found in the earlier work. It is concluded, however, from mass-balance data, that the chance of the glacier rising sufficiently in the next 25 years to be a danger to the mining installations near the snout of the glacier is much greater than was previously considered. The sensitivity of the theory to changes in input data is discussed. — Authors' abstract

Fisher, David E. *See* Bonatti, Enrico. 01531

Fitzgerald, John J. *See* Lipson, Herbert G. 01518

01461 **Fleck, R. J.** Tectonic style, magnitude, and age of deformation in the Sevier orogenic belt in southern Nevada and eastern California — Reply [to discussion by G. A. Davis and B. C. Burchfiel, 1971, of 1970 paper]: Geol. Soc. America Bull., v. 82, no. 5, p. 1437-1440, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 6, p. 1705-1720, 1970; Abs. North American Geology, January 1971.

01572 **Flint, Richard Foster.** Glacial and Quaternary geology: New York, London, John Wiley and Sons, 892 p., illus., tables, 1971.

This textbook takes account of studies in pollen stratigraphy, sea-floor stratigraphy, and isotopic geochemistry including radiometric dating, that have contributed significantly to Quaternary research since 1950, and integrates them into classic terrestrial glacial stratigraphy; it is the 3d edition and contains about 80 percent new

material. The 30 chapters discuss: late-Cenozoic climate and glaciation; development of concepts; glaciers of today; spatial distribution and volume of glaciers; glacial erosion, transport, sculptured terrain; glacial drift and morphology; drainage and eolian features; frost-action; weathering and soils, caverns stream regimens; sea-level fluctuation; glacial-isostatic deformation; stratigraphy, geochronology; late Wisconsin glaciers; stratigraphy and climate of North America; stratigraphy of Europe and deep-sea floors; Quaternary of other continents; Quaternary fossils; the problem of causes. — VSN

Fodor, R. V. *See* Sheridan, M. F. 01679

01984 **Fodor, R. V.; Keil, Klaus; Jarosewich, E.; Huss, Glenn I.** Mineralogy and chemistryof the Kyle, Texas, chondrite: Meteoritics, v. 6, no. 2, p. 71-79, illus., tables, 1971.

The Kyle, Texas, chondrite was identified in 1965. Electron microprobe analyses and microscopic examination show the following mineralogy: olivine (Fa 26.2 mole percent), orthopyroxene (Fs 21.0 mole percent), clinopyroxene, plagioclase (An 10.3 mole percent), chlorapatite, whitlockite, kamacite, taenite, troilite, chromite, and an iron-bearing terrestrial weathering product. Eutectic intergrowths of metaltroilite and a brecciated matrix indicate that the Kyle chondrite was shocked. Recrystallization and shock have obliterated chondrule-matrix boundaries. On the basis of bulk chemistry, composition of olivine and orthopyroxene, and the recrystallized matrix, the Kyle meteorite is classified as an L6 chondrite. — *from* Authors' abstract

Foglierini, F. *See* deBretizel, P. 01626

01783 **Foland, K. A.; Quinn, A. W.; Giletti, B. J.** K-Ar and Rb-Sr Jurassic and Cretaceous ages for intrusives of the White Mountain magma series, northern New England: Am. Jour. Sci., v. 270, no. 2, p. 321-330, illus., tables, 1971.

K-Ar biotite ages for 11 intrusions of the White Mtn. magma series or correlatives in New Hampshire, Vermont, and Maine form four groups: 216 m.y., Agamenticus complex; 183-168 m.y. (corresponding to previously accepted age for White Mtn. magma series), White Mtn. batholith, Mad River, Pilot-Pliny, and Cannon Mtn. stocks; 158-149 m.y., Gore Mtn. stock and Belknap complex; and 121-110 m.y., Merrymeeting stock, Ossipee, Mt. Ascutney, and Mt. Pawtuckaway complexes. Rb-Sr whole rock data on the Mad River stock (187 ± 4 m.y.) and Merrymeeting stock (110 ± 7 m.y.) confirm the age distinctions. The Conway granite, latest member of the differentiation series, yielded nine of the above dates. The time of Conway intrusion for each complex is limited to one of the above time groups. If progressive magma differentiation is assumed for the series, then at least two magma-source reservoirs are required. — *from* Authors' abstract

01507 **Ford, D. C.** Alpine karst in the Mt. Castleguard-Columbia Icefield area, Canadian Rocky Mountains: Arctic and Alpine Research, v. 3, no. 3, p. 239-252, illus., tables, 1971.

Mt. Castleguard and adjacent Castleguard Meadow in the southeastern Columbia Icefield are underlain by massive Middle Cambrian limestones with some shales and dolomite interbeds. The rocks dip gently southeast and are well karstified. Juxtaposition of karst, glacial, and periglacial erosion processes is observed. Above 2,300 m karst features occur on surfaces abandoned by Neoglacial ice. Meltwater sinks underground beneath extant glaciers. Shaft-type sinkholes, and karren occur in tundra below 2,300 m. Sinkholes aligned along shale contacts and distal edges of terminal moraines are randomly distributed elsewhere. Underground drainage developed in two phases. Castleguard Cave drained part of the Icefield downdip to springs at 2,000 m. It is a river passage which passes under Mt. Castleguard and has vadose and phreatic erosional elements. In late- or postglacial times the cave was abandoned and a new conduit developed which discharges at the Big Springs and is joined by drainage of Mt. Castleguard and the northern Meadows. — *from* Author's abstract

Ford, D. C. *See* Brown, M. C. 02009

01877 **Forman, Miriam A.; Stoenner, R. W.; Davis, Raymond, Jr.** Cosmic-ray gradient measured by the argon-37:argon-39 ratio in the Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4109-4120, illus., tables, 1971.

The gradient in the cosmic-ray intensity was deduced from measurements of the argon-37 (35-day half-life) and argon-39 (269-year half-life) activities in the metallic phase of the Lost City meteorite. A gradient of 60 ± 25 percent/AU, adjusted to solar minimum, was deduced from these activities and the known orbit of the meteorite. This high value of the gradient is about twice as high as that observed by the O'Gallagher-Simpson experiment on the Mariner 4 spacecraft in 1964-1965. — Authors' abstract

01789 **Forsyth, Jane L.** Geology of the Lake Erie Islands and adjacent shores [Introduction, road log] *in*Michigan Basin Geol. Soc. Ann. Field Excursion, 1971 [Guidebook]: [East Lansing?, Mich.] Michigan Basin Geol. Soc., p. 1-18, illus., 1971.

The islands are emerged tips of two cuestas on the eastern flank of Findlay Arch; one, Silurian, is the Put-in-Bay Dolomite, the other Devonian, the Columbus Limestone; no other cuestas appear in the thick carbonate sequence presented, with modified terminology for variously described units. Details of the complicated stratigraphy are discussed in a road log, and three accompanying papers. Gently tilted east, these units and younger strata were deeply eroded by a Mesozoic-Cenozoic stream system and by Pleistocene glaciers. There is evidence that a large preglacial trunk-valley of the buried Teays-age drainage was glacially deepened and widened to form the Erie basin. Subsequent history of the region includes a period when the western part of lake bottom was dry for thousands of years, then gradually flooded by slow isostatic rise of the Niagara outlet. — GDC

02067 **Foster, James B.; Pascale, Charles A.** Selected water resource records for Okaloosa County and adjacent areas: Florida Bur. Geology Inf. Circ., no. 67, 95 p., illus., tables, 1971.

Water resources records are presented for Okaloosa County, the upper drainage area of Shoal River, coastal areas in Walton County, and selected areas in Santa Rosa County for the period January 1966-September 1968. Interpretative results will be published later. Geologic and hydrologic information is tabulated with data grouped as follows: surface water, rainfall, or well records; water levels in well; ground-water pumpage; chemical analyses and temperature of ground water in Floridan and sand-and-gravel aquifers; and lithologic logs of selected wells. — VSN

Fredriksson, O. A. *See* Holser, W. T. 02037

01735 **Freeland, George L.; Dietz, Robert S.** Plate tectonic evolution of Caribbean-Gulf of Mexico region: Nature, v. 232, no. 5305, p. 20-23, illus., 1971.

A geotectonic history of the American Mediterranean is presented in terms of plate tectonics. The development of this region is presented as seven time sequence reconstructions from past Paleozoic to present times. — Authors' abstract

01995 **French, Bevan M.** Stability relations of siderite ($FeCO_3$) in the system Fe-C-O: Am. Jour. Sci., v. 271, no. 1, p. 37-78, illus., tables, 1971.

Stability relations of siderite in the system Fe-C-O were determined between 500 and 2000 bars in a CO_2 + CO atmosphere as a function of T, P_f [= $P(CO_2)$ + $P(CO)$], and oxygen fugacity, using solid-phase oxygen buffers. Siderite was synthesized for the experiments; procedures are given. The stability relations of natural iron-rich carbonates are more complex than those determined here for pure siderite because of presence of other volatile species in a natural gas phase and of water. Results indicate that reaction of natural iron-rich carbonates during metamorphism with available quartz and water to produce iron-rich amphiboles occurs at about 300-450°C. Conversely, coexistence of siderite + quartz in hydrothermal veins suggests temperatures below this value, and conversion of quartz-free siderite units to magnetite in contact-metamorphic aureoles occurs at temperatures exceeding 400-450°C. — VSN

01538 **French, Hugh M.** Ice-cored mounds and patterned ground, southern Banks Island, western Canadian Arctic: Geog. Annaler, Ser. A., v. 53, no. 1, p. 32-38, illus., table, 1971.

Small hydrolaccoliths are described which occur within low centered ice wedge polygons on poorly drained meadow tundra (Kellett) soils in the Masik Valley. It is suggested that the process of ice segregation is brought about by a contraction of the water saturated layer under cryostatic pressure and that the upstanding ice wedges, which bound the polygons, form the boundaries to the closed system. There is some similarity, therefore, between these features and the closed system pingos of the Mackenzie Delta with respect to genesis. — Author's abstract

01782 **Frick, Childs; Taylor, Beryl E.** *Michenia*, a new protolabine (Mammalia, Camelidae) and a brief review of the early taxonomic history of the genus *Protolabis*: Am. Mus. Novitates, no. 2444, 24 p., illus., tables, 1971.

In a brief taxonomic history of *Protolabis* Cope, 1876, the type species, *P. heterodontus*, is clarified, characters distinguishing the genus from *Miolabis* and *Procamelus* are discussed, and confused species are properly assigned. Besides *Protolabis*, the cameline tribe Protolabidini includes *Michenia*, n. gen., here diagnosed, smaller and slenderer than *Protolabis* and placed near the base of evolutionary radiation of the tribe. The type and only named species is *M. agatensis*, n. sp., from the middle Miocene (Hemingfordian) Marsland Formation, Sioux County, Nebr.; although its ancestry is unknown, it resembles the Arikareean camelid *Dyseotylopus migrans* from the Sespe Formation of California. Undescribed remains of *Michenia* are recognized in early Hemingfordian to late Clarendonian (lower Pliocene) deposits through much of western U.S. — VMJ

01798 **Friedman, Gerald M.; Gebelein, Conrad D.; Sanders, John E.** Micritic envelopes of carbonate grains are not exclusively of photosynthetic algal origin: Sedimentology, v. 16, nos. 1-2, p. 89-96, 1971.

This study re-emphasizes that organisms other than photosynthetic algae can bore into calcareous materials; fungi, bacteria, and heterotrophic algae are known to be active borers. Bacteria can be eliminated as producers of bores with diameters greater than about 10 μ; fungi create structures with radiating or branching patterns or bores of nonuniform size; and some fungal bores are indistinguishable from those known to have been bored by photosynthetic blue-green algae. No way is known to distinguish results of boring by photosynthetic algae from those of algae living heterotrophically. — VSN

Friedman, J. D. *See* Oldale, R. N. 01413

01528 **Fritz, P.** Geochemical characteristics of dolomites and the ^{18}O content of Middle Devonian oceans: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 277-282, illus., 1971.

Dolomite from Middle Devonian carbonate formations in northern Canada have been analyzed for their mineralogical and isotopic composition and trace amounts of sodium impurities. Three major groups are distinguised: 1) supratidal and early diagenetic dolomites with δ O-18 values between -1 and -4 per mil (PDB), more than 5 mol percent Ca CO_3 in excess and up to 700 ppm Na in impurities; 2) late diagenetic dolomites with δ O-18 values from -7 to -12.5 per mil (PDB), less than 5 mol percent Ca CO_3 in excess and less than 200 ppm Na in impurities; and 3) hydrothermal dolomites with δ O-18 values between -6 and -11 per mil (PDB), less than 2 mol percent Ca CO_3 in excess and less than 200 ppm Na in impurities. A comparison of supratidal dolomites with analogous recent dolomites indicates that the Middle Devonian ocean water had a lower O-18 content than modern oceans. — *from* Author's abstract

01828 **Frodesen, Eric.** Some primary sedimentary structures in the Lower Cherty Member of the Biwabik Iron Formation, Virginia Horn area [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 32-33, 1971.

Fruth, Lester S., Jr. *See* Donath, Fred A. 01552

08704 **Frye, John C.** The Ogallala Formation — A review, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 5-14, illus., 1970.

The Ogallala Formation was deposited in Late Miocene and Pliocene time in pre-existing valley systems across the Great Plains from southern South Dakota to central western Texas, by streams flowing from sources in the mountains. Late Tertiary or earliest Quaternary warping placed the coalescing alluvial deposits in a position vulnerable to Pleistocene erosion, and as a result they now stand as a plateau. The lower unit (Valentine) is variable in texture and character, but the deposits become more uniform upward. Geologic age is based on vertebrate faunas, but useful field correlation depends mainly on fossilized seed hulls. The hydrologic properties are strongly influenced by the predepositional topography, alinement of filled valleys and of major channel gravels, and hydrologic barriers — particularly buried soils in the upper half of the formation. — DBV

Fuller, M. *See* Dunn, J. R. 01483

Funkhouser, John. *See* Baxter, Murdoch. 01881

Furbish, William J. *See* Clarke, James W. 01568

01716 **Fyson, W. K.** Fold attitudes in metamorphic rocks: Am. Jour. Sci., v. 270, no. 2, p. 373-382, illus., 1971.

Recent studies of metamorphic rocks indicate that folds vary in style with time and crustal position in patterns that are remarkably similar in many orogenic belts. One pattern is the temporal change from recumbent to upright folding. In some areas, folds in rocks from deeper structural levels are mostly recumbent, whereas in overlying lower grade rocks, most folds are steeply inclined or upright. Accompanying a temporal change in the dip of axial surfaces there was a migration upward of the locus of maximum folding. Nevertheless, considering all examples, the common change in dip is not directly related to changes in metamorphic grade or to position in the tectonic pile. A tentative explanation of the deformation process interrelates temporal and spatial changes in fold attitude and suggests that a zone of horizontal translation was displaced downward. — *from* Author's abstract

02036 **Gabillard, Robert L. A.; Lounge, Francis C. J.; Bassiouni, Zaki A. F.; Desbrandes, Robert.** Telelog, an electromagnetic method of directional exploration at great distance from boreholes, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. S1-S19, illus., 1971.

The telelog, a new directional method of logging, consists of interpreting measurements of a low-frequency electromagnetic field propagated from the surface and received in a borehole. An analog model was used to bring out various phenomena and work out interpretation methods. A hydrocarbon reservoir (not penetrated by the borehole) was simulated on this model so as to set up various charts showing depth of the reservoir and its distance from the well. Field measurements were made; (France) the position of the gas reservoir edge, determined from the measurements and interpreted with the aid of charts drawn from the analog model, agreed with the true position, which was 900 m from the well. Typical field examples are given to illustrate use of the telelog in oil exploration around dry wells. Existing equipment can be used to locate a resistant anomaly with a contrast of 10, at a depth of 2,500 ft, 2,500 ft from the borehole. — DBV

01921 **Gaffney, Eugene S.; Hiatt, Robert.** A new baenid turtle from the Upper Cretaceous of Montana: Am. Mus. Novitates, no. 2443, 9 p., illus., table, 1971.

A new genus and species of baenid turtle, *Stygiochelys estesi*, is described from the Upper Cretaceous (Maestrichtian) Hell Creek Formation near Glendive, Mont. The new genus is based on a particularly well preserved skull; baenoids are among the

commonest turtles in Jurassic and Cretaceous deposits of North America, but the skulls, which furnish the most useful taxonomic and phylogenetic information, are relatively rare. The new skull is compared with that of the Upper Cretaceous *Eubaena cephalica* Hay, 1908, which it resembles more closely than other baenids; *Stygiochelys* has a triturating surface similar to that of *Eubaena*, but is distinguished from it by a number of features. — VMJ

01416 **Gale, Charles W., 3d.** The effect of a strong oxidizing environment on the stability of the gold iodide complex, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B140-B142, illus., tables, 1971.

Although manganese dioxide is an effective oxidant for formation of gold chloride and gold bromide complexes, it decreases the solubility of the gold iodide complex, because iodide, the complexing agent, is removed from the system by oxidation to iodine. In a laboratory study of possible mechanisms for movement of gold in natural systems, gold leaf was dissolved by addition of sodium iodide to a solution prepared to approximate copper porphyry input leach solutions used in recovering metals from porphyry copper dumps. The gold was then precipitated from solution by exposing the pregnant leach solution to an environment made strongly oxidizing by addition of manganese dioxide. — Author's abstract

Galle, O. Karmie. *See* Bowles, Frederick A. 01532

Galle, O. Karmie. *See* Magnuson, Larry M. 01981

01519 **Garland, George D.** Introduction to geophysics — Mantle, core, and crust: Philadelphia, London, Toronto, W. B. Saunders, 420 p., illus., tables, 1971.

This textbook outlines the means by which physics has provided a picture of the interior of the Earth and of the development of its surface features. It is designed for the student who has completed two years or more of college physics and mathematics. A knowledge of vector analysis is presumed. Properties of global significance are emphasized rather than description of individual surface features. Following introductory observations, 26 chapters are grouped under the major subjects of evidence from seismology, gravimetry, magnetic Earth, age and thermal state, and dynamic Earth. — VSN

01695 **Garlick, G. D.; Naeser, C. W.; O'Neil, J. R.** A Cuban tektite: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 731-734, illus., tables, 1971.

A large tektite from Cuba is classified with other North American tektites on the basis of its age. The major-element chemistry, oxygen isotopic composition, refractive index and density of the Cuban tektite are within the ranges exhibited by bediasites. — Authors' abstract

01870 **Garrels, Robert M.; MacKenzie, Fred T.** Gregor's denudation of the continents: Nature, v. 231, no. 5302, p. 382-383, illus., 1971.

Gregor's estimates of pre-human global denudation rate have been replotted and fitted as simple exponential functions by drawing two straight lines, one for Carboniferous to present and one for late Precambrian to Devonian. A model shows that 350 m.y. hence the relation of sedimentary masses to Meso-Cenozoic masses could be almost identical to the present relation of Meso-Cenozoic to Paleozoic. Thus the model explains Gregor's mass-age relations for the Phanerozoic on the basis of changes in the probability of destruction of sedimentary rocks as a function of their age, and his depositional rate for the Meso-Cenozoic cycle applies equally to the Paleozoic cycle. Two sedimentary cycles have occurred since late Precambrian, and the half-life of rocks during these cycles has been about 140 m.y. It takes 430 m.y. to deposit a mass of sediments equal to the total mass existing today. — DBV

02063 **Gartner, Stefan, Jr.** Calcareous nannofossil from the JOIDES Blake Plateau cores, and revision of paleogene nannofossil zonation: Tulane Studies Geology and Paleontology, v. 8, no. 3, p. 101-121, illus., 1971.

The calcareous nannofossil zonation for the Paleocene-Eocene has been refined by study of samples previously dated with planktonic foraminifers and of samples from continuous sections. One additional distinctive zone (*Cyclococcolithus robusta*) is recognizable in the Middle Paleocene. The middle and upper Eocene, formerly divided into two zones, is now divided into nine: the *Discoaster tani* s. l. — *Sphenolithus radians; Reticulofenestra umbilica — Sphenolithus furcatolithoides; Pemma papillatum; Bramlettelus serraculoides; Helicopontosphaera compacta — Chiasmolithus grandis; Hayella situliformis; Isthmolithus recurvus* (emended); *Sphenolithus predistentus — Discoaster barbadiensis;* and *Helicopontosphaera reticulata* zones. — DBV

Gaymard, R. *See* Poupon, A. 01764

01734 **Gazin, C. Lewis.** Paleocene primates from the Shotgun Member of the Fort Union Formation in the Wind River Basin, Wyoming: Biol. Soc. Washington Proc., v. 84, no. 3, p. 13-38, illus., 1971.

A fossiliferous horizon, rich in remains of vertebrates, particularly mammal teeth, was found in 1959 about 220 feet above the base of the Shotgun Member. Several papers have been published on this fauna, and the present one completes the author's studies. The fauna appears to be late Torrijonian in age. The primates listed are two Plesiadapidae, eight Paromomyidae, and two Carpolestidae, and include four new species, which are described and illustrated. — ESL

Gebelein, Conrad D. *See* Friedman, Gerald M. 01798

Gerhard, J. E. *See* Kirkland, D. W. 01794

Gershanovich, D. Ye. *See* Veber, V. V. 01723

01787 **Ghosh, A. K.; Scheidegger, A. E.** A study of natural wiggly lines in hydrology: Jour. Hydrology, v. 13, no. 2, p. 101-126, illus., tables, 1971.

The statistical characteristics of two river meanders [Salt Fork Vermilion River in Illinois; Assiniboine River in south-central Canada], two stretches of coast lines [California and Libya], and one watershed line [crest of Canadian Rocky Mts.] are investigated. In an attempt to produce these characteristics by a stochastic model by using a chain analog previously applied to meanders, it is shown that the required ensembles can be thus generated, if not only the sinuosity is specified, but also the "degree of wiggliness," a new quantity defined herein as an indication of the curvature of the line. Statistical analysis shows that these natural geologic wiggles are stochastic lines with normally distributed deviation angles, representing the expected path in an ensemble of all possible wiggly lines between two points, with given sinuosity and given degree of wiggliness. — GDC

02052 **Gibbs, Graham W.** The organic geochemistry of chrysotile asbestos from the Eastern Townships, Quebec: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 485-502, illus., tables, 1971.

Extractions of selected specimens of chrysotile from the Eastern Townships of Quebec yielded small quantities of organic material. Infrared and gas chromatographic studies indicate the presence of predominantly n-alkanes. These were probably derived by distillation from Precambrian sediments although a magmatic origin is not completely ruled out. Sample collection, handling, methods of analysis and problems associated with such studies of chrysotile are discussed. — Author's abstract

02057 **Gibson, Everett K.; Moore, Carleton B.; Lewis, Charles F.** Total nitrogen and carbon abundances in carbonaceous chondrites: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 599-604, illus., tables, 1971.

Total nitrogen and carbon abundances in twenty-seven samples of nineteen carbonaceous chondrites have been measured. The results obtained indicate that the meteorites enriched in nitrogen are similarly enriched in carbon. The results support

the previously observed trends with the highest carbon and nitrogen concentrations in Type I (C-1) carbonaceous chondrites with decreasing amounts in Type II and Type III (C-2, C-3, C-4) carbonaceous chondrites. The Vigarano and Ornans subgroups of the C-3 chondrites have differences in their carbon and nitrogen contents. — Authors' abstract

01986 **Gibson, Everett K., Jr.; Moore, Carleton B.; Lewis, Charles F.** Carbon and nitrogen abundances in selected achondrites: Meteoritics, v. 6, no. 2, p. 87-92, table, 1971.

Total carbon and nitrogen contents are reported for four howardites, three enstatite achondrites, and one hypersthene achondrite. The mean value for eucrites is 650 ppm C and howardites 1440 ppm C. The Haraiya eucrite has an anomalously high carbon content. The nitrogen contents range between 24 and 66 ppm N. The mean N value for eucrites is 36 ppm N and for howardites 51 ppm N. — Authors' abstract

Gilletti, B. J. *See* Foland, K. A. 01783

01446 **Gill, J. E.** Continued confusion in the classification of faults: Geol. Soc. America Bull., v. 82, no. 5, p. 1389-1392, illus., tables, 1971.

Drawings are given to show that fault classification based on *separations* (Hill, 1947) are misleading and should be dropped completely. Classifications based on relative movement between fault walls are valid. A revised classification is given here, which divides faults into two major categories, translational (inclined, vertical, horizontal) and rotational; types of faults within these categories are characterized according to movement and sense. — VSN

01901 **Gillott, J. E.** Mineralogy of Lead clay: Canadian Mineralogist, v. 10, pt. 5, p. 797-811, illus., tables, 1971.

The clay is a predominantly marine deposit of post-glacial age which accumulated in an arm of the ocean existing from 12,000 to 8,000 B.P., known as the Champlain Sea. Analyses of five samples were made by the petrographic microscope, by X-ray diffraction, differential thermal, and chemical analyses. Four samples contain mixed-layer clay minerals with an expansible component; all contain a significant proportion of chlorite, and of primary minerals, such as quartz, feldspar, and amphibole. Three of the samples were quite similar in mineralogy, a fourth did not contain two of the mixed-layer minerals, and the fifth showed the greatest differences. The minerals are thought to be detrital, and differences may reflect differences in original source area. — *from* Author's abstract

01432 **Giusti, Ennio V.** Regional specific yield of Coamo Fan, Puerto Rico, computed by water-budget method, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B248-B251, illus., table, 1971.

A regional value of 0.16 for specific yield was computed by the water-budget method for the Coamo alluvial fan in southern Puerto Rico for the calendar year 1967. This method may be used where dewatering of the aquifer is a major component of the water budget and where infiltration from rainfall and surface water is negligible or its effect can be calculated. For the Coamo fan, which is irrigated for agriculture, an average of one-third of the irrigation water was recirculated through the aquifer during the study year 1967. — Author's abstract

01871 **Glancy, P. A.** Sediment transport by streams in the Chehalis River basin, Washington, October 1961 to September 1965: U.S. Geol. Survey Water-Supply Paper 1798-H, 53 p., illus., tables, 1971.

Chehalis River drains an area of 2,100 sq mi in southwestern Washington of which 1,813 sq mi is in the study area. Average annual suspended-sediment discharge from the area during the years 1962-65 was about 540,000 tons; annual loads ranged from 270,000 to 690,000 tons. About 74 percent of suspended-sediment discharge was derived from Satsop and Wynoochee River drainage basins. Only about 24 percent was carried by Chehalis River past Porter. Estimated average annual suspended-sedi-

ment yield from tributary basins ranged from 20 to 1,500 tons per sq. mi. Most sediment transported in the basin originates from channel erosion during storm runoff. During the study period, 90 percent of suspended-sediment discharge occurred only 5-10 percent of the time at headwater sampling sites and 15-20 percent of the time at lower main-stem stations. Observed sediment concentrations ranged from less than 1 mg per l to 1,220 mg per l, and greatest concentrations were associated with tributary basins of highest yield. — *from* Author's abstract

Goh, K. M. *See* Stevenson, F. J. 02051

Goldberg, Edward D. *See* Bertine, K. K. 01686

01943 **Goldsmith, Victor; Colonell, Joseph M.** Effects of nonuniform wave energy in the littoral zone, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 767-785, illus. [1971].

Monitoring of beach profile stations on the northeast end of Monomoy Island (Cape Cod) over a 27-month period revealed major variations in amount of erosion and accretion along this Massachusetts shoreline. A close relation was observed between changes in the beach and offshore portions of the profiles. Variations in erosion and accretion occurring at any one time are related to the nonuniform distribution of energy within waves arriving at the coastline. This nonuniformity of energy is attributed to refraction of waves around the irregular bathymetry offshore from Monomoy and appears to produce shoreline protuberances of sand which are flanked updrift and downdrift by erosional zones. Wave refraction calculations indicate zones of alternately converging and diverging orthogonals in wave fronts impinging on Monomoy, with a correlation observed between zones of converging orthogonals and areas of the beach presently undergoing the greatest erosion. — *from* Authors' abstract

Goldsmith, Victor. *See* Hayes, Miles O. 01954

Goles, Gordon G. *See* Randle, Keith. 01704

01597 **Good, Charles William.** The ontogeny of Carboniferous articulates — Calamite leaves and twigs: Palaeontographica, ser. B. v. 133, nos. 4-6, p. 137-158, illus., 1971.

The anatomy and epidermal cell patterns of structurally preserved calamitean leaves attached to twigs lacking secondary wood are described from the Lower, Middle, and Upper Pennsylvanian: Breathitt Formation, Leslie County, Ky.; Carbondale Formation, Sahara locality, Ill.; Mattoon Formation, Berryville, Ill., respectively. Serial sections of *Calamites* sp. twigs from Kentucky reveal a five-sided pyramidal configuration of the apical cell, with square external upper surface and four internal triangular cutting surfaces, unlike the tetrahedral configuration in modern Equisetum, which the apical organization otherwise resembles; the leaves and twigs may belong to the plant that produced *Calamostachys binneyana* cones. The Berryville leaves and twigs, *Calamites rectangularis* Anderson, may belong to the plant that produced *Calamostachys americana* cones and *Arthropitys communis* var. *septata* stems. — VMJ

Goodman, Richard E. *See* Heuzé, Francois E. 01893

01889 **Goodwin, Bruce K.** Folding and tearing paper as an aid to visualizing geologic structures in three dimensions: Virginia Jour. Sci., v. 22, no. 1, p. 16-17, illus., 1971.

Many earth science students can not visualize structures in three dimensions, so geologic maps and structures they portray remain a mystery. This is particularly vital to studies of Virginia geology where the conspicuous Valley and Ridge Province is underlain by plunging folds and the outcrop pattern of resistant and non-resistant formations coupled with subsequent erosion has determined the position of prominent mountains and intervening valleys. Block diagrams could be used, but many students still do not seem to understand how various stages looked. A simple and less expensive method is to fold and rip sheets of paper. Instructions are given and illustrated, showing various stages in the development of eroded and non-plunging synclines and anticlines. — EHS

08752 **Goody, Peter C.** The Cretaceous teleostean fish *Cimolichthys* from the Niobrara Formation of Kansas and the Pierre Shale of Wyoming: Am. Mus. Novitates, no. 2434, 29 p., illus., 1970.

Despite a lengthy synonymy, it is apparent that *Cimolichthys nepaholica* (Cope), 1872, is the only species of the salmoniform genus represented in the Upper Cretaceous of North America; it occurs in the Niobrara Formation (Coniacean-Santonian) of Kansas (type material), and the Pierre Shale (Campanian) of Wyoming (also Kansas and Manitoba); the Wyoming material is described for the first time. The skull structure differs little from that of the type species, *C. levesiensis*, from the English Chalk, and supports the suggested relation of *Prionolepis* to the Cimolichthyidae (Goody, 1969). Structure of the caudal skeleton and fin is considerably specialized from the basal teleost plan; an anteroventrally extended sixth hypural is particularly advanced. These specializations, together with hypurostegy, deeply cleft caudal fin, strengthened caudal peduncle, and fusiform body, suggest pelagic fishes that were fast, active predators. — VMJ

01987 **Gooley, R.; Lewis, Charles F.; Moore, Carleton B.; Huss, Glenn I.** The Nazareth (b) meteorite: Meteoritics, v. 6, no. 2, p. 93-98, illus., 1971.

The Nazareth (b) meteorite is a medium octahedrite found in 1968 near Nazareth, Texas. It contains 8.75 percent nickel and large schreibersite inclusions. — Authors' abstract

01593 **Gorman, George C.; Wilson, Allan C.; Nakanishi, Mikiye.** A biochemical approach towards the study of reptilian phylogeny — Evolution of serum albumin and lactic dehydrogenase: Systematic Zoology, v. 20, no. 2, p. 167-185, illus., tables, 1971.

Albumin purified from blood plasma and H_4 isoenzyme of lactic dehydrogenase purified from heart tissue of the iguana were injected into rabbits, and the resulting antisera were tested for reactivity with the corresponding unpurified proteins from more than 50 other species. LDH reactivity was strong in other lizards and snakes, weak in the rhynchocephalian *Sphenodon*, crocodilians, turtles, and birds, none in amphibians and mammals; albumin reactivity was strong in iguanines, less strong in other iguanids, weak or none in non-iguanid lizards and snakes. Albumin has evolved about twice as fast as LDH, and more regularly, during lizard evolution, and at an equivalent rate in the Iguanidae and the mammalian orders Carnivora and Primates (in other studies); lizard families, according to the fossil record, are approximately as old as placental mammalian orders. Similar conclusions on crocodilians were drawn from studies of alligator albumin. — VMJ

Gottfried, David. *See* Anderson, A. T. 01468

Gough, D. I. *See* Camfield, P. A. 01505

Gough, D. I. *See* Porath, H. 01506

01508 **Graf, William L.** Quantitative analysis of Pinedale landforms, Beartooth Mountains, Montana and Wyoming: Arctic and Alpine Research, v. 3, no. 3, p. 253-261, illus., tables, 1971.

The spatial distribution of terminal moraines in alpine valleys can be quantitatively described using distance and regression models. Surface parameters indicative of age may also be numerically analyzed. Evaluation of postglacial modification of valley sides between terminal moraines provides an additional indicator of relative age of valley segments. Analysis of the geomorphology of Alpine features in the upper Rock Creek drainage in the southeastern Beartooth Mountains, Montana, shows that glaciers in this area deposited evidence of two Bull Lake, four Pinedale, and two Neoglacial advances. — Author's abstract

Grahek, F. E. *See* Cadle, R. D. 02053

01543 **Gray, N. H.** Kinetics of contact metamorphic processes: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 205-210, illus., tables, 1971.

If the temperature dependence of the kinetics of a contact metamorphic process can be described by the familiar Arrhenius rate equation and if its mechanism is known, both the activation energy and the frequency can be calculated from the extent to which the process occurred within the contact aureole during the cooling of an intrusion whose thermal history is well known. — Author's abstract

01486 **Green, H. W., 2d; Radcliffe, S. V.; Heuer, A. H.** Allende meteorite — A high-voltage electron petrographic study: Science, v. 172, no. 3986, p. 936-939, illus., 1971.

Electron-transparent sections of the Allende meteorite, a carbonaceous chondrite, have been prepared by ion-thinning and examined by high-voltage (800-kv) transmission electron microscopy. The matrix crystals, mainly olivine, range in size from approximately 5 to approximately 0.01 micrometers; carbon is present as intergranular films of poorly crystalline graphite. The chondrules exhibit extensive radiation damage, a feature lacking in the matrix. In addition, both chondrules and matrix are underformed and contain negative crystals; submicroscopic exsolution lamellae are present in pyroxenes. Comparison of the substructure in the Allende meteorite with that in the Parnallee meteorite and in lunar and selected terrestrial rocks leads to the conclusion that chondrule irradiation preceded cold accretion during formation of the solar system and that the meteorite has since been undisturbed. — Authors' abstract

Green, J. C. *See* Ojakangas, R. W. 01851

01804 **Green, John C.** Stratigraphy of the North Shore Volcanic Group northeast of Silver Bay, Minn. [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 20-22, tables, 1971.

01852 **Green, John C.** The North Shore Volcanic Group, *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 73-96, illus., tables, 1971.

Besides 11 pages of road log for Trip A, including short descriptions at stops, the paper discusses the regional setting of this volcanic group, paleomagnetism and age, structure, a general description, and a geologic sketch map. Characteristics of major lava types are tabulated. Stratigraphy of the group on the northeast limb (Tofte-Grand Portage) and that on the southwest limb (Tofte-Nopeming) are also given in tables. — ESL

01420 **Greenland, L. Paul; Rowe, J. J.; Dinnin, J. I.** Application of triple coincidence counting and of fire-assay separation to the neutron-activation determination of iridium, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B175-B179, tables, 1971.

Two procedures for determination of iridium in meteorites, ores, and rocks by neutron activation are described. Both require irradiation of 1-g samples for 12-16 hours in a neutron flux of 7×10^{12}n cm^{-2} sec^{-1}. In the first, applicable to iridium concentration of 1-1000 ppb, samples are counted directly with three NaI(Tl) detectors gated through single-channel analyzers; the multichannel analyzer records only events which pass single-channel analyzers. The second uses fire-assay separation for iridium concentrations of 0.001-10 ppb. Samples are fused in presence of iridium carrier to obtain a Pt-Rh-Ir bead. The final bead is counted in double coincidence to eliminate interference from Ag^{110m} and fission produced ruthenium. Both procedures require long counting times but are very fast in terms of man-work hours. — *from* Authors' abstract

01424 **Greenland, L. Paul; Campbell, E. Y.** Substoichiometric determination of tantalum by neutron activation, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B191-B193, tables, 1971.

A rapid radiochemical separation of tantalum utilizing substoichiometric extraction of the tantalum tetra-N-pentylammonium bromide (TPABr) complex for the chemical yield determination is described. After hydrofluoric-sulfuric acid or sodium peroxide decomposition of silicate rocks, tantalum is radiochemically purified by

methyl isobutyl ketone (MIBK) extraction from hydrofluoric-sulfuric acid media, back extraction to ammonium hydroxide, and chloroform extraction of the TPABr complex from hydrofluoric acid. Results from U.S. Geological Survey [standard] rocks are presented. — Authors' abstract

01819 **Greensfelder, Roger W.; Crice, Douglas.** A geodimeter measures fault movement and strain buildup along California's San Andreas system: Earthquake Inf. Bull., v. 3, no. 3, p. 7-12, illus., 1971.

This article describes the use of geodimeters since 1959 in measuring fault movement and strain buildup along the San Andreas fault system in California. The oceanic plate is known to be constantly moving northwestward along the San Andreas fault in relation to the continental plate in "jerky" movements. Stresses build up in the fault zone to the point at which the crustal rocks break as the plate edges snap past each other, releasing stored energy and causing an earthquake. This phenomenon has been monitored and verified in various areas by geodimeter data which recorded strain buildup for a period of 2-3 years preceding an earthquake, as well as the right-lateral crustal movement which occurred along the fault at the time. — EH

01891 **Greensfelder, Roger W.; Crice, Douglas.** Geodimeter fault movement investigations in California: California Geology, v. 24, no. 6, p. 105-109, illus., 1971.

To delineate areas of fault movement, repeated measurements were made with geodimeters of chains of survey lines criss-crossing faults in the San Andreas system. The greatest average rates of movement occurred between San Juan Bautista and Parkfield, and in the Imperial Valley, a right-lateral displacement averaging 4 cm/yr. In adjoining segments, strain is accumulating. Parts of the Hayward and Calaveras faults show displacement of 1 to 1.5 cm/yr. The elastic rebound theory is accepted as a satisfactory model for generation of earthquakes, and is confirmed by geodimeter data; magnitude of the shock depends upon amount of strain energy released. Two segments showing uneven movement are characterized by frequent intermediate earthquakes. North of Corralitos and south from Carrizo Plain, the fault is locked and characterized by infrequent major earthquakes. The current program stresses accurate strain measurement as an aid in earthquake prediction. — ESL

01711 **Greenwood, H. J.** Anthophyllite — Corrections and comments on its stability: Am. Jour. Sci., v. 270, no. 2, p. 151-154, illus., 1971.

An arithmetic error in the calculated stability (Greenwood, 1963) of anthophyllite relative to talc + enstatite is corrected. On the basis of data used in 1963, there is no change in the conclusion that equilibria reported are stable relative to talc and enstatite, but the upper pressure stability limit of anthophyllite occurs at extremely high pressures at temperatures over 600°C. Heats of reaction calculated by Orville and Greenwood (1965) are referenced to a sliding scale standard state of H_2O corresponding to ideal gas H_2O at 1 bar pressure. Allowing for this, results of Zen (1971) agree within stated uncertainties with those of Orville and Greenwood (1965). Thermodynamic data are inadequate at present to resolve relative stabilities of talc + enstatite and anthophyllite, but experimental data (Greenwood, 1963) strongly suggest that anthophyllite is stable in the temperature range 600°-800°C to 3 kb. — *from* Author's abstract

01598 **Gresens, Randall L.** Application of hydrolysis equilibria to the genesis of pegmatite and kyanite deposits in northern New Mexico: Mtn. Geologist, v. 8, no. 1, p. 3-16, illus., table, 1971.

Recent experimental studies of high-temperature hydrolysis equilibria between quartz, muscovite, K-feldspar, and Al_2SiO_5 are applicable to the petrogenesis of kyanite and pegmatite deposits in a Precambrian metamorphic terrane in northern New Mexico. If feldspathic rocks (metarhyolites) are presumed to have been subjected to hydrothermal activity by acid solutions during metamorphism, then a simple chemical model explains kyanite deposits as residues formed by intense hydrothermal leaching, quartz-muscovite schists as lesser-leached shear zones, and zoned pegmatites as a reaction product formed in reduced-pressure zones in quartz-

muscovite schist. The quartz cores of pegmatites are crystallized first as quartz veins secreted during early stages of dilatancy; the feldspathic border zones are formed later from reaction of fluids with quartz-muscovite schist as pressure is reduced further. Calculations based on chemical compositions of rock units support the hypothesis in several respects. — *from* Author's abstract

01467 **Griffin, Villard S., Jr.** The Inner Piedmont belt of the southern crystalline Appalachians: Geol. Soc. America Bull., v. 82, no. 7, p. 1885-1898, illus., 1971.

The Inner Piedmont belt probably represents the migmatitic infrastructural core of the southern crystalline Appalachians. This belt exhibits the widest area of high-grade metamorphic rocks in the southern Appalachians and is a broad zone separating structures overturned northwestward from those overturned toward the southeast. Three subparallel zones constitute the northeast-trending Inner Pidemont belt in South Carolina and northeastern Georgia. The Inner Piedmont core defines the axis and consists of an assemblage of sillimanite-grade rocks, including mica schist, biotite gneiss, granitoid gneiss, and minor amphibolite. The core is bounded by two flanks of kyanite-grade rocks of a similar character. Amphibolite and granitoid gneiss predominante within the flanks, and migmatization is locally intense. — *from* Author's abstract

Gross, D. L. *See* Lineback, J. A. 01702

08753 **Grossling, Bernardo F.; Johnston, John E.** On bridging the gap between raw remote-sensing data and resource and environmental information, *in* Photo-optical instrumentation for the 70's — Soc. Photo-Optical Instrumentation Engineers, Ann. Tech. Symposium, 15th, Anaheim, Calif., 1970, Proc.: Redondo Beach, Calif., Soc. Photo-Optical Instrumentation Engineers, p. 179-188, 1970.

A wide gap exists between (a) raw remote-sensor data (photographs, sensor imageries, line scans, or point measurements, and (b) resource information as needed by various units of a nation's economy. Vast amounts of remote-sensor data bearing on earth resources and environment will be collected repetitiously in the near future. Thus, a careful consideration should be given to the overall data-processing system that underlies the gathering and utilization of such information. Such a system encompasses a large variety of governmental and private entities. — Authors' abstract

Gunn, Bernard M. *See* Watkins, Norman D. 01470

08740 **Gussow, William Caruthers.** Heat, the factor in salt rheology, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 125-148, illus., with discussion, 1970.

Diapirism is temperature dependent and is initiated by heat. This greatly reduces the ultimate strength and eliminates work hardening. [It is postulated that] salt domes in the Gulf Coast area were intruded at a temperature of 300°C from depths exceeding 25,000 feet; piercement is rapid, driven hydraulically by the entire overburden pressure (25,000 psi), augmented by a small buoyancy differential which is a function of the height of the salt column and rarely reaches 2,500 psi; flow continues until the supply of plastic salt is exhausted. Many domes [of the world] reached the surface and formed mountains of salt 2000 to 4000 feet in elevation and has salt flows (or "glaciers"), which moved until they cooled below 200°C. The sea and rain removed most of the former salt mountains by solution, leaving anhydrite as cap rock. — *from* Author's abstract

02040 **Guy, James O.; Smith, W. D. M.; Youmans, Arthur H.** The sidewall acoustic neutron log, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. X1-X16, illus., 1971.

A Sidewall Acoustic Neutron logging instrument has been placed in limited field operation. In its present form it yields a simultaneous recording of an acoustic interval transit time (Δt) curve, a neutron porosity curve, a caliper curve, and an optional

gamma ray curve. The quality of information is as good or better than that obtained by conventional acoustic logging instruments. Simultaneous acquisition of acoustic-derived and neutron-derived porosity can be used for "quick look" detection of gas-bearing strata. The resolution of the sidewall acoustic curve permits thin bed reservoir analysis. The waveforms obtained have less borehole effect than those obtained with conventional acoustic sections. Examples are given of logs made under various conditions, and results are discussed. Information derivable from wave form studies is also considered. — DBV

02041 **Guyod, Hubert; Wichmann, P. A.** Theoretical notes on the resistivity of shaly sands, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Y1-Y13, illus., 1971.

Theoretical notes concerning the effects on the resistivity of shaly sands by various types of shale or clay distributions are presented. These are supported by calculations which point out, at least qualitatively, limiting values of these resistivities. Interspersed shales are treated mathematically as two distinct types: the case in which the shale particles are "floating" or exist in the pore spaces between the sand grains but without touching them, and the case in which the shale effectively coats the sand grains. An appendix gives the derivations of equivalent resistivities of the shale-water mixtures for the two models. Charts showing limiting resistivities for these two types of shaly sands are presented for the convenience of the practicing Log Analyst. They indicate that the resistivity of shaly sands is greatly dependent upon the geometry of the shale interspersed in the sand intergranular space. — Authors' abstract

Hafner, S. S. *See* Schürmann, K. 01684

01883 **Hales, Anton L.** Crustal and upper mantle structure in the region of the Gulf of Mexico (with Spanish and English abs.): Soc. Geol. Mexicana Bol., v. 32, no. 1 (1969), p. 63-70, illus., 1971.

Seismic refraction studies of the crust and mantle in the Gulf of Mexico region are described. The principal conclusion of the crustal studies was that the crust underlying the sediments in the deep portion of the Gulf Coast syneclise is thin relative to the crust in the central United States. The question of how thick bodies of sediments can be laid down is discussed. — Author's abstract

01912 **Haley, Boyd R.; Hendricks, Thomas A.** Geology of the Van Buren and Lavaca quadrangles, Arkansas and Oklahoma — Pt. 2 *of* Geology of the Arkansas Valley coal field: U.S. Geol. Survey Prof. Paper 657-A (also Arkansas Geol. Comm. Inf. Circ. 20-I), p. A1-A41, illus., tables, geol. map, 1971.

Middle Pennsylvanian rocks and Quaternary alluvial deposits are exposed here and wells have penetrated rocks of Early Ordovician to Middle Pennsylvanian age; their stratigraphy is given, and general lithology shown in sections. The rocks are in east-trending folds, their limbs broken by north- or south-dipping normal faults; one with displacement as much as 2500 feet separates the Arkansas Valley section from the Ozark Plateaus province. Folding and faulting started early in Atokan time. Coal is present in the Atokan, McAlester, and Savanna Formations; most economically important is the Lower Hartshorne coal bed, near base of the McAlester, with an estimated original reserve of 82,000,000 short tons, mostly in Arkansas. Natural gas has been found in Silurian and Mississippian rocks, but most is from the Atokan Formation of Pennsylvanian age. Building stone, road metal, and clay come from bedrock and alluvial deposits. — GDC

Hall, G. F. *See* Everett, K. R. 01455

01643 **Hall, Henry T.; Murthy, V. Rama.** The early chemical history of the earth — Some critical elemental fractionations: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 239-244, illus., tables, 1971.

Thermodynamic data for reactions relevant to upper parts of the Earth explain observed geochemical behavior of trace elements. Reactions in a primitive Earth un-

dergoing core formation through Fe-S liquid segregation indicate that alkali elements K, Rb and Cs will be strongly chalcophile and thus withdrawn into the core. Chondritic models for the Earth need not be discarded because of apparent depletion of alkalis from its silicate fraction. Segregation of K into the core will decouple heat production of K-40 from that of U and Th early in earth history. Subsequent thermal and differential history would contrast markedly with that obtained in existing models which employ a coherent relation between K and U in the Earth. The present model can explain evolution of radiogenic Pb and S[illegible] in the Earth, in addition to providing sufficient K-40 heat energy in the core to account for the geomagnetic field. — *from* Authors' abstract

Hall, Jack D. *See* Ratliff, J. R. 02034

01559 **Hall, Stephen T.** Geology field trip, *in* NSS-71 guidebook (Whittemore, R. E., editor): Region Rec., v. 1, no. 4, p. 131-134, illus., 1971.

Blacksburg, Va., is in the heart of the Appalachian Mts. which are here composed of faulted and folded rocks, ranging from Cambrian to Pennsylvanian in age. Regional stresses produced folds and faults, and erosional features were produced in more recent times. A geologic sketch map and section show the features to be seen. — ESL

01884 **Hall, Wayne E.** Geology of the Panamint Butte quadrangle, Inyo County, California: U.S. Geol. Survey Bull. 1299, 67 p., illus., tables, geol. map, 1971.

Panamint Butte quadrangle in central Inyo County, California, on the west side of Death Valley encompasses the northern parts of Argus and Panamint Ranges and Panamint Valley. The quadrangle is underlain by a sequence, more than 15,000 feet thick, of metamorphic and sedimentary rocks of Precambrian (?) and Paleozoic age, intruded by Mesozoic plutonic rocks and andesite porphyry dikes. The section is unconformably overlain by Cenozoic volcanic rocks and sedimentary deposits, Pliocene or younger. Paleozoic rocks were deformed into broad open folds before intrusion of the quartz monzonite plutons, and were then thrust and folded by Mesozoic intrusion of Hunter Mountain quartz monzonite batholith and other plutons. Cenozoic thrust faulting under shallow cover caused shattering of Paleozoic strata. Landslides occurred during late Cenozoic. Tertiary thrusting and consequent shattering caused chaos-type structures. — *from* Author's abstract

02084 **Hallenburg, James K.** A resumé of spontaneous potential measurements, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. H1-H16, illus., 1971.

Classically the potentials measured as an SP curve are made up of two components, electrochemical and electrofiltration; electrode effects can also be as important. The primary source of the electrochemical component is a difference in ion concentration and mobility; it is influenced by the makeup of both fluid and matrix. The electrofiltration component arises from differential pressure and ion composition. The electrode itself results in deflections and baseline shifts from which useful information may be extracted. Equipment must be designed and operated so as to cut down or eliminate spurious effects. More must be learned about interpreting the SP curve and instrumentation must be designed to select the useful parameters and reject the others. — DBV

01822 **Halls, H. C.; West, G. F.** Shallow structure and stratigraphy of the Lake Superior basin from seismic refraction measurements [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 23-24, 1971.

01823 **Halls, H. C.; West, G. F.** The Isle Royale fault [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 25-27, illus., 1971.

Hamilton, J. C. *See* Harrison, J. E. 01410

01919 **Hamilton, W. N.** Salt in east-central Alberta: Research Council Alberta Bull. 29, 53 p., illus., tables, isopach maps, 1971.

Rock salt deposits of commercial thickness and purity underlie a large area in east-central and northeastern Alberta extending into extreme northwestern parts of the province. They form part of the Middle Devonian Elk Point Group, containing four mappable salt units called, from oldest to youngest, lower Lotsberg, upper Lotsberg, Cold Lake, and Prairie Evaporite Salts. They attain a maximum thickness of nearly 1,400 feet in east-central Alberta, thinning gradually in all directions except northeast. The thickest, most extensive salt units are the upper Lotsberg and Prairie Evaporite Salts which exceed 500 and 700 feet at their respective depocenters. The Prairie Evaporite Salt ranges in depth from 700 feet in the northeastern part of the study area to 6,000 feet in the southwest. The upper Lotsberg Salt is 600 to 1,000 feet deeper but more favorable for industrial use due to its superior chemical quality. Non-salt strata are rare in the Lotsberg and Cold Lake successions; therefore, solution-mining recoverability of the salt is greatly enhanced. Magnesium and potassium salt concentrations in them are low. — *from* Author's abstract

Hammack, Gregory W. *See* Fertl, Walter H. 02035

01732 **Hammond, Allen L.** Plate tectonics — [Pt.] 2, Mountain building and continental geology: Science, v. 173, no. 3992, p. 133-134, 1971.

The development of plate theory has led to a new theory relating mountain building to the destruction of oceanic crust in a trench and collision of continental masses. Attempts to interpret mountain belts in terms of plate tectonics involve reexamination of the literature as well as new field studies of critical areas. Relatively young ranges are associated with current plate boundaries. Mountain building by plate motions prior to the last 200 m.y. is suggested by studies of older mountain ranges. The success of plate theories in explaining more recent geology has convinced some that continents evolved in a continuous process. A related problem concerns geochemical differentiation of the Earth. Plate theory may also have an impact on some fields of biology (paleoecology). — DBV

01774 **Hammond, Allen L.** Earthquake prediction and control: Science, v. 173, no. 3994, p. 316, 1971.

Interest in earthquake prediction has been renewed by the advent of plate tectonics. It is now thought that it is the locked sections of faults like the San Andreas, where no movement has been observed for the last 100 years, that are the likely sites for future shocks. Following the experience at Denver, where small and medium-sized earthquakes have been attributed to forced injection of fluid wastes into deep wells, the U.S. Geological Survey began monitoring the effects of injection and then pumping out wells in the Rangely oil field in western Colorado. The results so far seem to confirm the idea that the fracture strength of rocks, and hence resistance to sliding along the fault, is universely related to pore pressure, so that raising the fluid pressure will lower the point at which the rock will fracture under stress. This raises the possibility that fluid pressure might be used to limit earthquakes to magnitudes 4 or 5 by controlling the length of fault allowed to slip at one time. — DBV

Hammond, S. R. *See* Malahoff, A. 01459

Hands, Edward B. *See* Saylor, James H. 01947

Hannell, F. G. *See* McCann, S. B. 01623

Hansen, John. *See* Lövborg, Leif. 01501

01824 **Hanson, G. N.; Catanzaro, E. J.** Reliability of U-Pb ages of sphene in northeastern Minnesota and northwestern Ontario [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 28, 1971.

Hanson, G. N. *See* Prince, L. A. 01842

01785 **Hardie, Lawrence A.; Eugster, Hans P.** The depositional environment of marine evaporites — A case for shallow, clastic accumulation: Sedimentology, v. 16, no. 3-4, p. 187-220, illus., 1971.

As a model for early depositional stages of many ancient marine evaporites, details of sedimentary structures and textures in the upper Miocene Solfifera Series of Sicily indicate a shallow lagoon-littoral flat complex, much of it detrital. Interpretation based on studies of modern Bahaman tidal flats for mechanical and hydrologic aspects, and Persian Gulf and Baja California sediments for chemical aspects indicate that: gypsum sandstones accumulated periodically in very shallow shoals formed by wind-driven currents; laminations formed on a shore face storm-flooded with sediment-charged sea water and flat-pebble conglomerates, when storm waves ripped up algal bound, mudcracked gypsiferous layer; gypsum nodules, like anhydrite, formed within exposed skeletal sand just above the ground-water table; and large selenite crystals grew in increments during deposition. — GDC

Hardy, M. P. *See* Brown, E. T. 01655

01663 **Hardy, M. P.** Derivation of the "Griffith locus" for indirect tensile strength tests: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 123-129, illus., 1971.

The finite element method is used to extend Berry's derivation of the "Griffith locus" to any type of indirect tensile strength test. The analytical method is explained and illustrated by an example using the ring test geometry. It is concluded that the derivation of a force-displacement curve for each test using the surface energy material property is more meaningful than assuming that the tensile strength value calculated for the direct tension test is relevant in other situations. — Author's abstract

01777 **Harker, R. Ian.** Synthetic calcareous pseudomorphs formed from siliceous microstructures: Science, v. 173, no. 3993, p. 235-237, illus., 1971.

Individual of the diatom *Coscinodiscus* have been treated hydrothermally in the presence of lime and carbon dioxide with the result that they have become calcite pseudomorphs. The silica of the original diatoms has been replaced while the intricate reticulations of the alveoli have been preserved down to submicroscopic detail. — *from* Author's abstract

02085 **Harmon, Russell S.** Preliminary results on the ground-water geochemistry of the Sierra de El Abra region, north-central Mexico: Natl. Speleol. Soc. Bull., v. 33, no. 2, p. 73-85, illus., tables, 1971.

Chemical analyses of 35 ground-water samples were performed using standard wet-chemical and atomic absorption techniques. Most samples were analyzed in the field for pH, Ca, bicarbonate and dissolved oxygen concentrations. Most waters were found to be saturated with respect to calcite and undersaturated with respect to dolomite. Extremely high Ca^{2+}/Mg^{2+} ratios of the cave waters indicate derivation from a high purity limestone (the El Abra Limestone), while low ratios of the surface waters indicate a source outside the El Abra region. Carbon dioxide pressures, and thus Ca concentrations at a given saturation level, were at least an order of magnitude larger than those for karst waters of the eastern and southern United States. Calculations indicate a rate of carbonate solution of about 25 m^3 per yr for an area of about 1,500 sq km. The large volume of these Mexican caves appears to be directly proportional to the greater amounts of carbon dioxide and water available for the solutional process. — *from* Author's abstract

01897 **Harris, D. C.; Burke, E. A. J.** Eskebornite, two Canadian occurrences: Canadian Mineralogist, v. 10, pt. 5, p. 787-796, illus., tables, 1971.

The first Canadian occurrence of eskebornite from Martin Lake [mine] and the Eagle Group [Claims] Lake Athabaska area, northern Saskatchewan is reported. Electron microprobe analyses show that the formula is $CuFeSe_2$. The X-ray powder diffraction patterns are identical to that of eskebornite from Tilkerode, Germany, the type locality. Eskebornite occurs as island remnants in, and replaced by, umangite

which occurs in pitchblende ores in the basalt of the Martin formation and in granitized mafic rocks of the Eagle group. The mineral can be readily synthesized at 500°C from pure elements in evacuated silica glass tubes. Reflectance and micro-indentation hardness measurements are given. — Authors' abstract

01907 **Harris, D. C.; Owens, D. R.** A tellurium-bearing canfieldite, from Revelstoke, B.C.: Canadian Mineralogist, v. 10, pt. 5, p. 895-898, tables, 1971.

Canfieldite [$Ag_8(Sn,Ge)S_6$], with Sn > Ge, is a rare sulphosalt mineral, often formulated as the pure end-member of the canfieldite-argyrodite series. The first occurrence of a tellurium-bearing canfieldite is reported, in a lead-zinc-silver ore from a prospect near Revelstoke. The ore consists chiefly of sphalerite, pyrite, and galena, with lesser stannite. The canfieldite occurs as small inclusions in galena, often at its contact with pyrite. It is isotropic in reflected light and appears medium gray. X-ray diffraction data for the series, and electron microscope analysis are tabulated. — ESL

Harris, D. C. *See* Petruk, W. 01974

Harris, R. L. *See* Craig, J. R. 02066

01725 **Harris, Stuart A.** Quaternary vulcanicity in the Talamanca Range of Costa Rica: Canadian Geographer, v. 15, no. 2, p. 141-145, illus., 1971.

Radiocarbon dates determined on humus in buried soils under ashfalls south of El Empalme in the Cordillera de Talamanca of Costa Rica give evidence that volcanic activity took place between 17,000 and 8,400 yr B.P. across the range. This activity, possibly produced by fissures with no accompanying cone development, resulted in the deposition of successive ash deposits, each with a buried soil, as well as of short lava flows, small scoria deposits and scattered blocks of agglomerate. The active volcanic belts of this area may have divided into two ranges in post-glacial times. Possibly there were up to 5,400 radiocarbon years between ashfalls. — EH

01410 **Harrison, J. E.; Hamilton, J. C.** Minor-element changes in pelitic belt rocks caused by metamorphism in the Pend Oreille area, Idaho-Montana, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B82-B91, illus., tables, 1971.

Changes in trace-element content during regional and contact metamorphism of certain Belt argillites and siltites have been examined by means of quantitative spectrographic and wet chemical analyses. Identification of changes during metamorphism is complicated by a considerable range in original content plus increased variability in both rock types during metamorphism. Trends suggest loss of B, Co, Cr, and Ni, and perhaps Ba, Pb, Sc, and V. Sr and perhaps Ga have increased in contact-metamorphosed rocks. Data on Cu do not indicate clearly whether the Cu content has increased or decreased during metamorphism. They do indicate that Cu has been redistributed to some degree, which suggests that metamorphic processes should not be discarded as potential contributors to stratabound copper deposits in Belt rocks. — Authors' abstract

01955 **Harrison, W.; Byrne, R. J.; Boon, J. D, 3d; Moncure, R. W.** Field study of a tidal inlet, Bimini, Bahamas, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1201-1222, illus., tables [1971].

The channel bottom is bare beach rock or is floored with bioclastic sands and gravels. A nine-day series of observations of current speed and direction and water temperature and salinity was obtained at two depths at eight stations using telemetering sensor packages. Twelve-18-min pulsations in flow were often observed. Evolution of sand ripples and dunes was monitored over a 200-ft distance during one tidal cycle. The growth pattern illustrates differences in bedform geometry which may influence friction coefficients. Evidence is presented for a bottom jet induced by flow over crests of sand waves. Sampling of color-coded tracer sand, released on a flood cur-

rent, was done. Spatial distribution of tracers in relation to bedforms and the importance to grain erosion of a natural mucoid coating are noted. — *from* Authors' abstract

Harward, M. E. *See* Borchardt, G. A. 01629

01989 **Hatcher, Robert D., Jr.** Stratigraphic, petrologic, and structural evidence favoring a thrust solution to the Brevard problem: Am. Jour. Sci., v. 270, no. 3, p. 177-202, illus., tables, 1971.

The Brevard fault zone extends from near the edge of the Coastal Plain in Alabama northeastward to near the Virginia line in North Carolina. The pattern of repetition of stratigraphic units, stratigraphic control of structure, exotic slices of Shady Dolomite and basement, and truncation of units to the northwest points to the conclusion that faulting within the Brevard Zone is thrust faulting. The zone is on the northwest limb of the Low Rank Belt synclinorium. It is thought that the thrust is a backlimb segment developed in association with the Blue Ridge thrust movement and occurred during late Paleozoic. Faulting was facilitated by incompetent rocks in the northwest limb of the earlier-formed synclinorium. —*from* Author's abstract

01587 **Hathaway, John C.** (editor). Data file, Continental Margin Program, Atlantic Coast of the United States — V. 2, Sample collection and analytical data: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Ref. No. 71-15), 496 p., illus., tables, 1971.

This data file is based on magnetic tape storage of information on samples collected or studied as part of the joint U.S. Geological Survey-Woods Hole Oceanographic Institution, Atlantic Continental Margin Program. Volume 2 contains sample collection and analytical data on samples obtained through December 31, 1970, and supersedes Volume 1, supplement 1 (Woods Hole Oceanog. Inst. Ref. No. 67-21). [Data include lithology, biology, grain-size analysis and grain-size parameters, sand-fraction and carbonate-fraction compositions, carbon and nitrogen contents, natural gamma radioactivity, and X-ray diffraction, clay minerals, heavy minerals, gravel, and chemical analyses]. — *from* Author's abstract

Hauff, P. L. *See* Dyni, John R. 01425

01578 **Haug, Pat; Schnoes, H. K.; Burlingame, A. L.** Studies of the acidic components of the Colorado Green River Formation oil shale — Mass spectrometric identification of the methyl esters of extractable acids: Chem. Geology, v. 7, no. 3, p. 213-236, illus., table, 1971.

A study of solvent extractable acidic constituents of oil shale from the Colorado Green River Formation (ca 50×10^6 years) is presented. Identification of individual components is based upon gas chromatographic and mass spectrometric data obtained for their respective methyl esters. Normal acids (C_7-C_{18}), isoprenoidal acids (C_9, C_{18}), α,ω-dicarboxylic acids (C_{12}-C_{18}), mono-α-methyl dicarboxylic acids (C_{13}, C_{18}) and methyl ketoacids (C_{11}, C_{14}) were identified. In addition, the presence of monocyclic, benzoic, phenylalkanoic and naphthyl-carboxylic acids, as well as cycloaromatic acids, is demonstrated by partial identification. — Authors' abstract

01903 **Haughton, D. R.** Plagioclase-scapolite equilibrium: Canadian Mineralogist, v. 10, pt. 5, p. 854-870, illus., tables, 1971.

An electron microprobe study of coexisting plagioclase and scapolite demonstrates that scapolite is generally more calcium-rich than the coexisting plagioclase. However, at high calcium contents the reverse is true. The tendency for the calcium content of scapolite to increase with increasing calcium content of plagioclase is evident. Analysis of random scapolite standards indicate that a high SO_3 and CO_2 potential favours the stability of meionite while a high CL_2 potential favours the stability of marialite. — Authors' abstract

08728 **Haupt, W.; Walther, C.** The determination of the stresses in a potash-salt pillar (with French summ.), *in* Canadian Symposium on Mining Surveying and Rock Deformation Measurements, 1st, Fredericton (New Brunswick), 1969, Proc.: Fredericton, Univ. of New Brunswick, p. 342-348, illus., 1970.

Measurement of stresses in pillars in potash mines is very problematic because of the very inelastic behavior of the salt. An attempt has been made to analyze the stresses on a solid pillar in place. For this, the stresses on the edge of the pillar were ascertained by the compensation method, using new steel hydraulic cells, as this method only works with the elastic components of the strain behavior of salt. Stresses within the pillar, where a hydrostatic stress state is presumed to prevail, were measured directly by strain gages. Stress distribution in the pillar can be estimated from the results. — DBV

01653 **Haworth, Richard T.** Comment on paper by J. Northrop, M. F. Morrison, and F. K. Duennebier, "Seismic slip rate versus sea-floor spreading rate on the eastern Pacific rise and Pacific Antarctic ridge" [1970]: Jour. Geophys. Research, v. 76, no. 17, p. 4047-4048, 1971.

For the paper under discussion see ibid., v. 75, no. 17, p. 3285-3290, 1970; see Abs. North American Geology, February 1971.

01954 **Hayes, Miles O.; Goldsmith, Victor; Hobbs, Carl H., 3d.** Offset coastal inlets, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1187-1200, illus. [1971].

Offset coastal inlets are common on the coasts of New England and the northern Gulf of Alaska. In both areas the dominant waves approach the shore at an oblique angle resulting in a strong net littoral drift. The most common type of offset on these coasts is a downdrift offset (the downdrift side of the inlet protrudes further seaward than the updrift side). Wave refraction around ebb-tidal deltas at the inlets is an important process in the formation of downdrift offsets, as it creates a local reversal in drift direction just downdrift of the inlet and allows sediment to accumulate there. Associated with the offset is a segregation of tidal current flow in the inlets, with the ebb flow being more channelized than the flood. The type of inlet offset at any one location can vary through time. Results of studies at Hampton Harbor, New Hampshire, inlet from 1776 to the present are given. — *from* Authors' abstract

01687 **Hecht, Alan D.; Savin, Samuel M.** Oxygen-18 isotopes of recent planktonic foraminifera [Reply to discussion by A. W. H. Bé and J. van Donk of 1970 paper]: Science, v. 173, no. 3992, p. 168-169, illus., 1971.

For paper under discussion, *see* ibid., v. 170, no. 3953, p. 69-71, 1970; Abs. North American Geology, April 1971.

02072 **Hecht, Alan D.; Schmitt, Thomas J.** Faunistic paleotemperatures of Pleistocene foraminiferal assemblages [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 124, 1971.

02047 **Hedge, C. E.** Nickel in high-alumina basalts [discussion of papers by S. R. Taylor, 1969, and by S. R. Taylor and others, 1969]: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 522-524, illus., 1971.

New analyses of high-alumina basalts reveal an average nickel content higher than previously indicated. Ni in high-alumina basalts correlates with magnesium in the same way as it does in other basalt types. There is therefore no reason, based on Ni contents, to hypothesize a special origin for high-alumina basalts and it is permissible (based on Ni contents) to form andesites by fractional crystallization from high-alumina basalts. [For paper under discussion *see* Oregon Dept. Geology Mineral Industries Bull. 65, p. 43-64, 1969; Geochim. et Cosmochim. Acta, v. 33, p. 275-286 and p. 1555-1557, 1969; Abs. North American Geology, July 1970.] — Author's abstract

Heirtzler, J. R. *See* Pitman, W. C., 3d. 01541

02050 **Helgeson, Harold C.** Kinetics of mass transfer among silicates and aqueous solutions: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 421-469, illus., tables, 1971.

Theoretical and empirical considerations suggest that kinetics of mass transfer among aluminosilicates and aqueous solutions can be described by a simple parabolic rate law consistent with diffusional mass transfer and applicable to incongruent as well as congruent reactions. Precipitation of reaction products can be described by reversible chemical reactions and equilibrium thermodynamics. The activation energy for the reaction of feldspar with an aqueous phase to produce boehmite and/or kaolinite is about 8,700 cal per mole. Predicted phase equilibria, mass transfer, and reaction paths are nearly identical to those observed experimentally. Thermodynamic calculations afford detailed interpretation of results of experimental kinetic studies, evaluation of complicated chemical reactions in multicomponent systems and prediction of mass transfer in geochemical processes in terms of space-time coordinates. — DBV

Hempkins, W. B. *See* Timur, A. 02082

Hendricks, Thomas A. *See* Haley, Boyd R. 01912

Hendrickson, Ronald A. *See* Mengel, Joseph T., Jr. 01836

02017 **Henika, William S.** Geology of the Bassett quadrangle, Virginia: Virginia Div. Mineral Resources Rept. Inv. 26, 43 p., illus., tables, geol. map, 1971.

The southeastern and central parts of the Bassett quadrangle in southern Franklin and northern Henry Counties of Virginia are underlain by schist, gneiss, amphibolite, and granitic and gabbroic intrusive rocks of uncertain age. The northwestern part of the quadrangle is underlain by Moneta gneiss and the Lynchburg Formation. The schist unit is composed of a mica schist with altered sillimanite and of a mica schist with altered staurolite and garnet. The Moneta gneiss is a plagioclase-mica gneiss interbedded with augen gneiss, quartz diorite gneiss, actinolite gneiss, and schist, and quartzite. The Lynchburg unconformably overlies the Moneta gneiss, contains metagraywacke, mica schist and phyllite, metabasalt, graphite schist, talc-dolomite schist and termolite-chlorite schist, and is intruded by metamorphosed gabbro sills. The rocks of uncertain age are intruded by porphyritic felsite dikes and Triassic diabase dikes. Two major folds occur — the Reed Creek syncline and the Cooper Creek anticline. Talc is the only mineral product being produced. — *from* Author's abstract

Hennion, John. *See* Edgar, N. Terence. 01866

Henvey, T. L. *See* Palmer, D. F. 01514

01958 **Herbich, John B.** Comparison of model and beach scour patterns, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1281-1300, illus., tables [1971].

Artificial or natural barriers are divided into those from which waves are reflected and those on which waves break. Intermediate types may set up severe erosive action of the beach in front of barriers. When reflected waves are superimposed on incident waves a stationary spatial envelope of combined incident and reflected waves is produced. Previous laboratory studies indicated that crests of the sand bed appear fairly closely under the nodes of the envelope and troughs of the scoured sand bed under the loops of the envelope. The predominant scouring pattern had a spacing between crests of one-half the wave length. Studies on parameters for bar and trough depth were compared with beach profiles along the Texas Gulf Coast. Relations between scour depth and sand crest wave length, between trough depth and sand bar depth, and between wave characteristics and beach scour were established for selected locations. — *from* Author's abstract

Herbst, Emmett L. *See* Eargle, D. Hoye. 08738

01463 **Heron, S. Duncan, Jr.; Judd, James B.; Johnson, Henry S., Jr.** Clastic dikes associated with soil horizons in the North and South Carolina Coastal Plain: Geol. Soc. America Bull., v. 82, no. 7, p. 1801-1809, illus., 1971.

Clastic dikes are common in many areas of the Carolina Coastal Plain. They begin within the B soil horizon, taper downward, usually about 5 feet, and are not confined to any one formation. Some of the dikes are oriented parallel to hillslopes and some are associated with collapse structures. These clastic dikes probably were formed through the filling of fractures by soil materials developed in the upper B horizon, and the fractures probably developed in weathered rock by slumping and(or) hillside creep. — EHP

Heron, S. Duncan, Jr. *See* Clarke, James W. 01568

02058 **Herzog, G. F.; Anders, Edward.** Absolute scale for radiation ages of stony meteorites: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 605-611, illus., tables, 1971.

Absolute production rates of He-3 and He-21 in average L-chondrites have been determined from a least-squares fit of noble-gas to Al-26 data, for meteorites of age $<2 \times 10^6$ yr in which Al-26 has not been built up to saturation levels. The values obtained, 2.48 ± 0.23 and $0.466 \pm 0.031 \times 10^{-14}$ ccSTP g^{-1} yr^{-1}, are 24 percent higher than conventional values, based on He-3 measurements. Apparently all published radiation ages of stony meteorites based on conventional production rates are too high by 24 percent. — Authors' abstract

01592 **Hess, Paul C.** Polymer model of silicate melts: Geochim. et Cosmochim. Acta, v. 35, no. 3, p. 289-306, illus., tables, 1971.

The distribution of silicate species in silicate melts is analyzed using the techniques of conventional polymer chemistry. The structure of a melt is dominated by the SiO_4 monomer at low silica compositions. With increasing SiO_2, the silicate species polymerize forming larger branch and ring structures. Infinitely branched species have a high probability of forming once one-third of the singly bonded oxygens of the silicon atoms become doubly bonded to two silicon atoms. In most binary silicate melts, this point is reached at mole fractions SiO_2 between 0.28 and 0.44. The extent of polymerization of a melt can be expressed as a constant, K. This constant can, in turn, be correlated to the field strength of the cation that is added as an oxide. Cations of high field strength form the most polymerized melts. These highly polymerized melts are characterized by liquid immiscibility at high silica compositions. — Author's abstract

Hester, Norman C. *See* DuMontelle, Paul B. 01737

Heuer, A. H. *See* Green, H. W., 2d. 01486

01893 **Heuzé, Francois E.; Goodman, Richard E.; Bornstein, Ann.** Numerical analyses of deformability tests in jointed rock — "Joint Perturbation" and "No Tension" finite element solutions [with German and French abs.]: Rock Mechanics, v. 3, no. 1, p. 13-24, illus., table, 1971.

Sound design of structure in or upon rock requires knowledge of the rock mass deformability. Field test data interpretation has generally relied upon analytical or finite element linear elastic solutions. When testing in jointed rock, since the medium cannot resist the tension induced upon loading, other solutions are required. If discontinuities of the rock mass can all be mapped and their surface properties determined, the finite element model will use a "Joint Perturbation" solution where the "joint" elements have variable stiffness to account for movements along fractures. If discontinuities cannot be satisfactorily mapped, a global approach is provided by a "No Tension" analysis of "stress transformer" type. The two techniques are compared in the case of bore hole jack deformability tests and found to agree well, indicating an appreciable difference from results of linear elasticity. — *from* Authors' abstract

08732 **Heyl, A. V.** Some aspects of genesis of stratiform zinc-lead-barite-fluorite deposits in the Mississippi Valley, United States, *in* Problems of hydrothermal ore deposition; the origin, evolution and control of ore-forming fluids — Symposium, St. Andrews, Scotland, 1967: Stuttgart, Germany, E. Schweizerbart'sche Verlagsbuchhandlung (Internat. Union Geol. Sci., Ser. A, no. 2), p. 95-99, illus., 1970.

Most stratiform deposits of Mississippi Valley type in the United States are epigenetic and have been deposited by hydrothermal (hot water) solutions, probably of different genesis in different regions. A few sulfide-bearing deposits, such as pyrite beds in carbonaceous shales, siderite nodules containing sulfides, and some geodes have been deposited by syngenetic, diagenetic, or meteoric solutions, but all important commercial districts show evidence of deposition by one or another of several types of hydrothermal solutions. In the Mississippi Valley, evidence suggests that solutions depositing ores were basin brines heated to about 100°C by deep-seated alkalic magmas and enriched in the several districts by different proportions of metals and various trace elements in a smaller fraction of magmatic water. Commercial deposits of syngenetic, diagenetic, and meteoric origin are also known in the region. — *from* Author's conclusions

Hiatt, Robert. *See* Gaffney, Eugene S. 01921

Hilchie, D. W. *See* Engelke, C. P. 02080

Hill, D. G. *See* Runge, R. J. 02083

01745 **Hillel, Daniel.** Soil and water — Physical principles and processes: New York and London, Academic Press (Physiological Ecology series), 288 p., illus., tables, 1971.

The physical principles governing the soil-water system, particularly the sequence of processes constituting the cycle of water in the field, are described for the use of students and professional workers in soil physics and other related disciplines (geology, hydrology, geography, etc.). A basic knowledge of physics and mathematics is assumed. Part 1, physical principles, discusses: basic physical properties of soils, physical properties of water, state of water in the soil, flow of water in saturated and unsaturated soil. Part 2, the field water cycle, discusses: infiltration-entry of water into soil, redistribution of soil moisture following infiltration, ground-water drainage, evaporation from bare-surface soils, uptake by plants, water and energy balance in the field. Two appendices on mathematical procedures and a reference list are included. — VSN

01453 **Hinkle, M. E.** Determination of mercury in crude oils, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B171-B174, illus., tables, 1971.

The frequent association of mercury with solid and liquid hydrocarbons in mercury deposits and with petroleum in oil wells makes determination of mercury content of hydrocarbon materials imperative to fuller understanding of geochemistry of mercury. In the proposed procedure the oil sample is quickly and completely oxidized in an oxygen flask, combustion products are absorbed in dilute chlorine water, and dissolved mercury is collected on a silver screen immersed in the chlorine-water solution. The screen is heated, and evolved mercury is measured by a mercury-vapor absorption detector. From 10 to 400 nannograms of mercury can be detected in a 0.05-ml oil sample; this content is equivalent to 0.2-8 ppm mercury. — *from* Author's abstract

01867 **Hintze, William H.** Depiction of faults on stratigraphic isopach maps: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 871-879, illus., 1971.

This paper demonstrates [graphically] the proper techniques for depicting faults on isopach maps. Expressions of faults are of much greater width on isopach maps than on accompanying structure maps. Moreover, isopach lines do not stop at a fault trace, but continue across it in a distinctive fashion which is quite different from that of structure contours. Where faults cross or bifurcate, or die out within a formation, they also exhibit characteristic patterns on isopach maps. Isopach lines near ends of

faults, and in situations where bed thickness equals or exceeds fault throw show typical attitudes, as do isopach-map features produced by high angle reverse faults. — *from* Author's abstract

01825 **Hinze, William J.; Davidson, Donald M.; Roy, Robert F.** Continental rifts [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 29, 1971.

Hinze, William J. *See* Kellogg, Richard L. 01830

Hinze, William J. *See* O'Hara, Norbert W. 01841

02078 **Hirashima, G. T.** Availability of streamflow for recharge of the basal aquifer in the Pearl Harbor area, Hawaii: U.S. Geol. Survey Water-Supply Paper 1999-B, 26 p., illus., tables, 1971.

The Pearl Harbor area is underlain by a basal aquifer that contains large supplies of fresh water. A cap rock of sedimentary material less permeable than the basaltic lava of the aquifer retards seaward movement of ground water. Although pumping for agricultural use has decreased since 1931, net ground-water discharge has increased because of urban use. This increase may cause an increase in chloride content from wells near the shore, unless increased discharge is balanced by increased recharge to the aquifer by direct infiltration and deep percolation of rain, excess irrigation water, seepage through streambeds or from outside the area. Because streams are flashy and have a wide range of discharge, only 60 percent of the average annual runoff can be diverted to recharge areas by ditches or reservoirs, and because of suspended sediment use of streamflow poses problems. Practical tests are needed to determine advantages and disadvantages of types of recharge structures. — EHS

01936 **Hird, John M.** Control of artesian ground water in strip mining phosphate ores, eastern North Carolina: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 149-156, illus., table, 1971.

Control of artesian ground water has played an important role in the development of Texas Gulf Sulphur's phosphate mining venture in eastern North Carolina. To facilitate dry mining methods, 60 million gpd of fresh water is pumped through wells from a limestone aquifer underlying the uniform flat-lying ore section. Hydrologic information revealed from pumping tests has been used in successfully developing a depressurizing system. Computer assistance is used to plan well patterns. High volume pumping has lowered water levels in water wells over a large area in the Coastal Plain without detrimental effects on water quality in the aquifer. Cooperative effort between mining firms will be required to control the ground water as new mines are developed in the district. An intricate observation well system is monitored regularly over the wide area of pumping effect to ensure that gradient reversals have not caused salt water encroachment. — Author's abstract

02076 **Hitchon, Brian; Billings, Gale K.; Klovan, J. E.** Geochemistry and origin of formation waters in the western Canada sedimentary basin — [Pt.] 3, Factors controlling chemical composition: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 567-598, illus., tables, 1971.

Twenty major and minor chemical components are reported for 78 formation waters from oil fields and gas fields in Alberta, Canada. The volume-weighted mean composition is similar to that of present day sea water and is compelling evidence for an ultimate origin from sea water of the major portion of the dissolved salts in the formation waters. Dilution by fresh water recharge and concentration by membrane filtration, the major factors controlling chemical composition, produce a chemical population ranging from freshwater to brines. Factors controlling the present composition are discussed. — DBV

Hobbs, Carl H., ed. *See* Hayes, Miles O. 01954

Hoering, Thomas C. *See* Puchelt, Harald. 02059

02038 **Hoffman, G. W.** Recognition of potentially producible oil and gas zones in cased holes with neutron lifetime logs, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. V1-V10, illus., 1971.

Pulsed neutron logging offers a means of calculating water saturation in the completed cased hole or in the open hole under favorable conditions. A means has been devised to present a value of apparent water-filled "porosity" from the Σ curve. Overlaying this value on an independently derived log of true porosity, recorded on a compatible linear scale, yields a visual estimate of water saturation. The overlaid curves will stack in zones of 100 percent water saturation and "separate" in regions of interest. A unique combination acoustic-epithermal neutron cement bond tool complements pulsed neutron logging; On a second run it simultaneously records acoustic and neutron porosities through bonded casing, and also identifies minerals and secondary porosity. The existence and quality of cement bond can be detected and evaluated using the "half wave acoustic signature" presentation now available with the combination tool. — DBV

Hofstra, W. E. *See* Jenkins, C. T. 08713

01628 **Hogberg, R. K.** Environmental geology of the Twin Cities Metropolitan Area: Minnesota Geol. Survey Educ. Ser. 5, 63 p., illus., 1971.

This booklet illustrates the significance of geology to the total environment of the Twin Cities Metropolitan Area in relation to agriculture, surface- and ground-water supply, waste-disposal, mineral resources, building materials and foundations and other engineering geological problems. — EH

01807 **Holland, Charles Hepworth.** (editor). Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, 456 p., illus., tables, 1971.

This book consists of six sections by separate authors, five of which are cited in this volume. Chapters cover the Great Basin of the western United States, the craton of the United States, the Appalachian and eastern New England regions, Canada and Alaska, and the North American arctic regions, including Greenland. — EH

Holland, H. D. *See* Stollery, G. 01500

08756 **Holmgren, Dennis A.** K/Ar dates and paleomagnetics of the type Yakima Basalt, central Washington, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 189-199, illus., table, 1970.

Although they cannot delineate specific flows, replicate whole-rock K-Ar dates from late Cenozoic basalts in Yakima Canyon do indicate that the intra-Ellensburg Pomona flow is distinctly younger than the Yakima Basalts. These and previous Columbia River Basalt dates generally fall in the 14-18 m.y. interval, but conceivably the rocks could have been formed in less than a million years. The paleomagnetic section is the same in both Yakima Canyon and the Columbia River gorge — reversed lower flows overlain by normal, followed in turn by a transitional flow, and capped by reversed flows. The three mappable type Yakima Basalt units in central Washington are directly correlatable with flows of the Columbia River gorge. — DBV

02037 **Holser, W. T.; Unterberger, R. R.; Brown, R. J. S.; Roberts, F. A.; Fredriksson, O. A.** Radar logging of a salt dome [abs.], *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. U1, 1971.

01558 **Holsinger, John R.; Whittemore, Robert E.** Karstlands excursion to southwest Virginia, *in* NSS-71 guidebook (Whittemore, R. E., editor): Region Rec., v. 1, no. 4, p. 124-130, illus., 1971.

The day-long geological field trip includes two of Virginia's most interesting karst areas, Ward Cove and Rye Cove (Natural Tunnel), as well as some of the most extensive limestone regions. Valleys follow crests of anticlines and mountains rest in troughs. One of the most impressive features of the karst is Dungannon Sink, 1.2 mi wide, 2 mi long, and 120-150 feet deep. Rye Cove is a karst "plateau" covering about 15 sq mi in a synclinal complex bounded by the Clinchport and Hunter Valley faults. Drainage is underground and surface karst features are well developed; 35 caves have been explored, and four contain large streams. — ESL

01942 **Horikawa, Kiyoshi; Watanabe, Akira.** Turbulence and sediment concentration due to waves, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 751-766, illus. [1971].

A new electrolytic turbulence transducer has been developed in order to measure the turbulent velocity fluctuation superposed on the oscillatory flow velocity. The aim of the present paper is firstly to describe the outline of this transducer and secondly to introduce some of the experimental results. The main results are: (1) the vertical distribution of turbulence intensity averaged over one wave on the movable bed of wave flume, and (2) the correlation between the turbulence intensity and the characteristics of sediment particles at the same level such as their fall velocity and sediment concentration. — *from* Authors' abstract

Horn, B. M. *See* Horn, D. R. 01924

01924 **Horn, D. R.; Ewing, M.; Delach, M. N.; Horn, B. M.** Turbidites of the northeast Pacific: Sedimentology, v. 16, nos. 1-2, p. 55-69, illus., table, 1971.

The northeast corner of the Pacific Ocean is a region of turbidity-current activity. Cores from this area are dominated by very fine-grained sand and medium-grained silt that grade upward to clay. Results presented here are based on 217 textural analyses of turbidite layers comprising 30 piston cores. Proximal and distal facies of turbidites are distinguished using characteristics of layering, grading, and texture. Features of proximal facies include wide range of layer thickness, maximum layer thickness, non-grading, truncation of grading, textural reversals, and sand at the base of graded layers. Areas beyond main routes of submarine flows are sites of episodic addition of silt- through clay-sized sediment. Proportion, thickness, and mean grain size of silt decreases with increasing distance from main avenues of flow. — *from* Authors' abstract

01971 **Horowitz, Alan Stanley; Potter, Paul Edwin.** Introductory petrography of fossils: New York-Heidelberg-Berlin, Springer-Verlag, 302 p., illus., tables, 1971.

Thin-section study of carbonate rocks, long slighted, is a key to stratigraphy and sedimentology; composition of skeletal debris is often difficult or impossible to obtain by any other technique. To simplify identification and use of major fossil groups in petrography, this book attempts to orient the user toward their major shapes and features as viewed in thin section, without excessive paleontological terms and detailed systematics, assuming some knowledge of introductory paleontology and the petrographic microscope. Four chapters discuss: organization of the book; overview of carbonate petrography and place of biotic constituents in this field; group by group description of skeletal architecture, mineralogy and microstructure, distribution, and comparisons; plates and plate descriptions. — GDC

02045 **Horvath, S. B.** The accuracy of petrophysical parameters as derived from computer processing [abs.], *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. CC1, 1971.

Hosterman, John W. *See* Bowles, Frederick A. 01532

01444 **Howard, Alan D.** Simulation model of stream capture: Geol. Soc. America Bull., v. 82, no. 5, p. 1355-1375, illus., table, 1971.

Stream capture is investigated through use of a simulation model involving capture within rectangular stream networks on a square matrix. Simulation rules make probability of capture of a stream by a lower adjacent stream proportional to the advantage in gradient of the potential path of capture between the streams compared to the present gradient of the higher stream. Stream elevations are defined by a linear relation between logarithms of gradient and drainage area; the slope of this relation, Z, is variable in nature and is the main adjustable parameter in the model. For a given value of Z, the statistical properties of networks formed after repeated captures are nearly the same for a wide range of assigned initial networks; when Z changes during capture, statistical properties of resultant networks may depend upon type of change, so that properties may be partially inherited from earlier stages. — *from* Author's abstract

01666 **Howarth, Richard J.** FORTRAN IV program for grey-level mapping of spatial data: Internat. Assoc. Math. Geology Jour., v. 3, no. 2, p. 95-121, illus., 1971.

A FORTRAN IV computer program for grey-level mapping of spatial data using a CDC 6600 computer is described. The program produces maps for irregularly distributed data in as many as 10 intensity levels which are displayed in grey tones by a lineprinter. Unlimited map size and unrestricted data input provide for as many as 5,000 data points per 13-in-wide strip of map. The program is easily modified for other installations. Examples are given of mapping of geochemical analyses of stream sediment. — *from* Author's abstract

Howe, D. A. *See* Craig, J. R. 02066

01440 **Hoyer, Marcus C.** Puget Peak avalanche, Alaska: Geol. Soc. America Bull., v. 82, no. 5, p. 1267-1284, illus., table, 1971.

The 1964 Alaska earthquake caused four phenomena at the head of Puget Bay: a large rock-snow avalanche, sea waves, tectonic uplift, and cracks in valley alluvium. The avalanche, which began as a large rockfall of jointed and fractured bedrock from Puget Peak, transported $1.8 \times 10^6 m^3$ of debris at speeds of more than 100 kph. Evidence along the avalanche track indicates that the avalanche mass traveled at high speed along its entire course. Similar avalanches have occurred at Puget Bay in the past and will occur again, because shattered bedrock and steep slopes remain on Puget Peak. — *from* Author's abstract

Hoyer, W. A. *See* Lock, George A. 02043

Huang, P. M. *See* Somasiri, S. 01562

Hubbard, H. A. *See* White, W. S. 01849

01826 **Hubbard, Harold A.** Keweenawan geology of the Porcupine Mountains, western Upper Peninsula, Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 30, 1971.

01827 **Huber, N. King.** The Keweenawan geology of Isle Royale, Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 31, 1971.

01423 **Hubert, A. E.** Determination of tellurium in geologic materials in the parts-per-billion range, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B188-B190, tables, 1971.

A sensitive method useful in geochemical exploration has been developed for the determination of tellurium in geologic material. In this method the sample is digested with hydrobromic acid and bromine, and the tellurium is extracted into methyl isobutyl ketone and stripped from the organic phase with water. Tellurium is then measured indirectly by its catalytic action on the reduction of gold by hypophosphorous acid. Results by this method compare favorably with those obtained by atomic absorption. The lower limit of sensitivity by the catalytic method is 5 ppb, whereas ex-

isting atomic absorption methods provide a sensitivity of 100 ppb. — Author's abstract

Hudson, J. A. *See* Brown, E. T. 01655

01656 **Hudson, J. A.; Brown, E. T.; Rummel, F.** The controlled failure of rock discs and rings loaded in diametral compression: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 33-49, illus., 1971.

Diametral compression of discs (Brazilian test) and of rings induces a zone of tensile stress in the specimens. If, as load is increased, failure occurs in the tensile zone, then these tests can be regarded as indirect methods of measuring tensile strength. Control of specimen failure was achieved with a closed-loop servo-controlled testing machine. Tests on specimens of charcoal-gray granite, Solenhofen limestone, and Tennessee marble reveal that neither the Brazilian test nor the ring test can be recommended as a method of measuring the *material property* "tensile strength." — DBV

Hudson, J. A. *See* Roegiers, J. C. 01660

Hudson, J. A. *See* Voegele, M. 01664

01661 **Hudson, John A.** Studying time dependent effects in failed rock: Minnesota Univ. Mineral Resources Research Center, Progress Rept., no. 24, p. 104-109, illus., 1971.

With the advent of closed-loop servo-controlled testing machines, it is now possible to achieve virtually any required boundary conditions and all aspects of the effect of time on the complete stress-strain curve for rock can be studied. The mode of operation of such a machine is described, and an example is given of stress relaxation in marble. Studying time dependent effects in failed rock by use of a servo-controlled testing machine will result in a clearer understanding of the failure process and hence a better design of excavations in rock. — DBV

01422 **Huffman, Claude, Jr.; Shaw, Van E.; Thomas, J. A.** Chromium content of U.S. Geological Survey standard rocks PCC-1 (peridotite) and DTS-1 (dunite), *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B185-B187, tables, 1971.

Chromium determinations by colorimetric and atomic absorption spectrophotometric methods were made on PCC-1 (peridotite) and DTS-1 (dunite). The average chromium content of PCC-1 is 2864 ppm and DTS-1 is 4275 ppm. The analysis of variance for a three-way cross classification design showed that there was no significant difference between bottles (splits) of either rock; thus the samples may be said to be homogeneous. — Authors' abstract

Hughes, Randall E. *See* Bohor, B. F. 01645

02005 **Hunkins, Kenneth; Bé, Allan W. H.; Opdyke, Neil D.; Mathieu, Guy.** The late Cenozoic history of the Arctic Ocean, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 215-237, illus., tables, 1971.

This paper summarizes past studies and presents new data on cores collected from ice island T-3. Sediment types from four processes are recognized: normal pelagic, ice-rafted, turbidity currents, and volcanic glass shards. Most cores from ridges and rises contain the first two types, are most useful for climatic studies, and are banded dark brown and light tan. All Alpha Cordillera cores have a dark brown layer, rich in foraminifera, in the top 10-15 cm. Ages range from about 70,000 yr B.P. to the present. Paleomagnetic data are in fairly good accord and are compatible with radioisotope-dating. *Globigerina pachyderma* is the predominant planktonic foraminifera, and still lives in the Arctic Ocean. The abundance and coiling direction of this species, and amount of insoluble ice-rafted material, are climatic indicators. — ESL

01963 **Hurlbut, Cornelius S., Jr.** Quartz: Mineral Digest, v. 1, p. 62-73, illus. [1971,].

Of the nearly 2,000 mineral species, none compares with quartz in diversity of origin and occurrence, abundance of varieties, and manifold uses. More than any other mineral it has been the birthplace and testing-ground for concepts and methods of mineralogy. The rather complex structure of quartz shows tetrahedral groups arranged like a spiral staircase about the long axis, and the direction of the spiral determines the "handedness" of the crystals. At present, 10 silica minerals are known, with quartz the most important. They can be divided into coarse- and fine-grained varieties. Coarse-crystalline varieties include: clear, milky, amethyst, citrine, smoky, and rose. The fine-grained varieties lack any external evidence of crystallinity. Chalcedony is a fine-grained fibrous type of quartz, divided into carnelian, agate, onyx, and moss agate. Granular types of fine-grained quartz are: flint, chert, and jasper. Of 10 color photographs, all but one are agates. — ESL

Huss, Glenn I. *See* Fodor, R. V. 01984

Huss, Glenn I. *See* Gooley, R. 01987

01747 **Hutchison, J. Howard.** Cf. *Uintatherium* (Dinocerata, Mammalia) from the Uintan (middle to late Eocene) of southern California: PaleoBios, no. 12, 8 p., illus., table, 1971.

North American uintatheres were previously known only from the Rocky Mountain region (Wheeler, 1961), but two fragmentary uintatheriid specimens, a mandible with M_3 and M_2 and an axis, have been collected from sea-cliff exposures of a sandstone lens in the middle Eocene portion of the Rose Canyon Formation near La Jolla, San Diego County, Calif. Comparison of the M_3 length with those of the uintatheriines *Tethiopsis*, *Eobasilius*, and *Uintatherium anceps* shows closest resemblance to the last; the fragmentary axis also agrees with that of *U. anceps*. Lack of diagnostic and comparative material, however, necessitates only a provisional assignment to *Uintatherium*. An isolated, extremely worn molar from an unnamed fluviatile formation below the upper Eocene Poway conglomerates also seems referable to Uintatheriinae. — VMJ

Huxsaw, Carol L. *See* Johnson, Stanley S. 02018

Hyde, L. W. *See* Newton, J. G. 01675

01886 **Imbrie, John; Kipp, Nilva G.** A new micropaleontological method for quantitative paleoclimatology — Application to a late Pleistocene Caribbean core, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 71-181, illus., tables, 1971.

This method extracts from data on planktonic microfossils an objective and quantitative estimate of the physical state of surface waters. It is based on an ecologic response model in which m species respond parabolically to m-1, or fewer, independent physical parameters t. Because the method requires that biologic variates be statistically independent, raw data on abundance of n species are resolved by factor analysis into m end-member, varimax assemblages. Quantitative data on planktonic foraminifera in 61 core tops distributed about the Atlantic conform to the model; four assemblages relate to surface temperature, a fifth to surface water productivity. Paleoecologic equations specifying physical parameters of the ocean as a function of observed assemblage abundance fit the data. Data on 110 samples spaced at 10-cm intervals down a Caribbean core are expressed in terms of the assemblages, and the equations applied for environmental estimates. — *from* Authors' summary

01421 **Ingram, Blanche L.; May, Irving.** Determining fluoride in rocks with a specific ion electrode, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B180-B184, tables, 1971.

Fluoride in distillates obtained from rocks can be determined with fluoride specific ion electrodes equally well by linear null-point potentiometry or by electrode calibration. High blanks may result from decomposition products generated during distilla-

tion and from organic matter originating from tubing and indicators. Fluoride can be determined with the fluoride electrode in phosphate rocks without separation. Interference by aluminum is controlled by adding sodium citrate. — Authors' abstract

01627 **Iranpanah, Assad.** Clay petrology and zonation of the uppermost shale member of the Ada Formation (Pennsylvanian), Seminole and Pontotoc Counties, Oklahoma: Oklahoma Geology Notes, v. 31, no. 3, p. 51-55, illus., 1971.

The uppermost member of the Ada Formation consists of dark-gray, yellow-gray, pale-red, grayish-orange shales interbedded with fine-grained calcareous sandstones. On the basis of clay mineralogy the member is divisible into four units composed of nonoriented clays with microscopic clay galls and some silicified fossil fragments. The distribution of clay-mineral constituents both laterally and vertically reveals that montmorillonite occurs predominantly in shales of the lowermost unit and decreases upward, illite and chlorite increase toward the top of the member, and montmorillonite predominates in shales from southern outcrops, and illite and chlorite in northern outcrops. — VSN

08706 **Irwin, James H.; Morton, Robert B.** Hydrogeologic information on the Glorieta Sandstone and the Ogallala Formation in the Oklahoma Panhandle and adjoining areas as related to underground waste disposal [abs.], *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 30, 1970.

Ito, H. *See* Dunn, J. R. 01483

01682 **Ives, Jack D.; Fahey, Barry D.** Permafrost occurrence in the Front Range, Colorado Rocky Mountains, U.S.A. [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 105-111, illus., table, 1971.

Little is known about permafrost occurrence in high mountain regions of the world. Preliminary results of permafrost studies from the Colorado Rocky Mountains are presented. Above tree line (about 3500 m) in the Front Range, scattered patches of permafrost begin to occur under wet sites blown free of snow in winter with a mean annual air temperature of -1.0°C. At greater elevations, with lower mean annual air temperatures, permafrost becomes more extensive and probably exceeds 60 m in thickness. These initial results are derived from a skeleton ground-temperature observation program supplemented by indirect evidence and by data gathered from engineering and mining operations in the high country. Probably under higher summits and ridge crests the alpine equivalent of the continuous zone of Arctic permafrost can be anticipated. — *from* Authors' abstract

Jacob, Klaus H. *See* Ward, Peter J. 01775

01699 **Jacobs, J. A.** Boundaries of the Earth's core: Nature Phys. Sci., v. 231, no. 25, p. 170-171, 1971.

Reestimation of the adiabatic gradient in the core still finds it slightly less than the melting point gradient; however, in the outer core there may not be much difference between the melting point and adiabatic gradients, and essentially none in the inner core. Parts of the mantle may at times become soluble in the outer core, or parts of the outer core may solidify on to the mantle, giving rise to irregularities on the boundary. The inner-outer core boundary may be a liquid-solid phase change or a compositional boundary. If the topography of either boundary influences core motions, then changes in geomagnetic polarity may well be random. However, an adiabatic gradient like that estimated by Higgins and Kennedy would inhibit radial components of convection in the outer core, necessitating reconsideration of the driving mechanism of the geomagnetic dynamo. — DBV

Jaeger, H. *See* Berry, W. B. N. 01471

01479 **James, Noel P.; Mountjoy, Eric W.; Omura, Akio.** An early Wisconsin reef terrace at Barbados, West Indies, and its climatic implications: Geol. Soc. America Bull., v. 82, no. 7, p. 2011-2017, illus., table, 1971.

A discontinuous reef terrace, 0 to 4.5 m above sea level dated at approximately 60,000 yr B.P. by Th-230 and Pa-231, occurs along the northwest coast of Barbados. This terrace developed as a narrow fringing reef during the last relatively warm period (St. Pierre interstadial), prior to sea-level lowering and extensive glaciation of the "Early" Wisconsin. Interstadial terraces like this one were formed about 28,000, 45,000, and 65,000 yr ago and are exposed today only in areas such as Barbados that have undergone subsequent uplift. — Authors' abstract

01946 **James, William R.** A class of probability models for littoral drift, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 831-837 [1971].

Probability models are presented for estimating volume littoral drift rate. — EH

01791 **Janssens, A.** Preliminary report on the stratigraphy of Upper Silurian rocks of western Ohio, *in* Michigan Basin Geol. Soc. Ann. Field Excursion, 1971 [Guidebook] — Geology of the Lake Erie Islands and adjacent shores: [East Lansing?, Mich.] Michigan Basin Geol. Soc., p. 30-36, 60-63, illus., table, 1971.

Existing nomenclature does not adequately reflect the Upper Silurian stratigraphy of this area. A reference well in Lucas County (see Appendix) shows: between the Tymochtee and Carman's Put-in-Bay dolomites, about 230 feet of section not defined in outcrop; difficult-to-recognize distinguishing features in underlying Greenfield Fm.; Tymochtee boundaries lost in expansion of its type section and in differential upper truncation. In other variously described Bass Island sections, there seem to be no criteria to apply outcrop nomenclature to the post-Tymochtee section in this well or in more than 40 others in western Ohio. Put-in-Bay and Raisin River are not suitable units for regional mapping; a new type section is needed for strata above the Tymochtee and below the Bass Islands Formation. — GDC

Jaroszewich, E. *See* Fodor, R. V. 01984

Jaroszewich, Eugene. *See* Clarke, Roy S., Jr. 01758

01806 **Jeletzky, J. A.** Biochronology of Jurassic — Cretaceous transition beds in Canada: Canada Geol. Survey Paper 71-16, 8 p., illus., 1971.

Fossil-rich, marine uppermost Jurassic and earliest Cretaceous sections recently discovered in western British Columbia, Richardson Mountains-Porcupine Plain trough, and Sverdrup Basin are characterized by complete development of Jurassic-Cretaceous boundary beds and persistence of high marine regime across the boundary. Some Berriasian beds of these sections in western British Columbia yielded mixed faunas of tethyan ammonites, boreal ammonites, and buchias. In correlating boundary beds of these regions with one another and with classical ammonite zones and stages of the tethyan and boreal realms of Europe, the Jurassic-Cretaceous boundary in Canada is placed between the basal Berriasian *Buchia okensis* s. str. and the latest Tithonian (= latest Volgian) *Buchia terebratuloides* s. lato-*Buchia* n.sp. aff. *okensis* zones. Time equivalents of the Canadian zones are present in the type area of the upper Tithonian and Berriasian stages in southeastern France. — *from* Author's abstract

08713 **Jenkins, C. T.; Hofstra, W. E.** Problems of artificially recharging the Ogallala Formation in Colorado, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 154-164, illus., 1970.

Two studies relating to artificial recharge were made in the northern High Plains of Colorado in 1969. A water availability study in Kit Carson County indicated that less than 1 percent of the average annual precipitation (16 in.) leaves the basin, too little for construction of large recharge projects. However, significant natural recharge occurs in some ephemeral stream channels. A test-drilling study showed that many poorly permeable lenses in the Ogallala Formation inhibit recharge of the aquifer. However, one hole near a dry wash penetrated only permeable beds. Scarification or excavation of stream beds may sometimes be warrented to increase recharge to the

water table. Some water might be salvaged from playas, by pumping for reuse into cropped land or by recharging it into the aquifer through wells. — DBV

Jenkins, Edward D. *See* McClain, Thomas J. 08709

Johnsen, S. J. *See* Dansgaard, W. 08743

Johnson, Henry S., Jr. *See* Heron, S. Duncan, Jr. 01463

02070 **Johnson, J. W.** Seasonal bottom changes Bolinas Bay, California, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1383-1396, illus. [1971].

Five bottom surveys over a period of a year were made in the north portion of Bolinas Bay, California. Comparisons between successive surveys permitted an evaluation of the areas and depths of scour and fill with the seasons and were correlated with littoral current measurements. Data for a 22-year period also were available on the position of the mean high-tide line over a limited length of beach. These data showed a cyclic variation of the position of the high-tide line with the season with the most variation from year to year occurring during the spring months. — Author's abstract

01885 **Johnson, Kenneth S.; McCasland, Willard.** Highway geology in the Arbuckle Mountains and Ardmore area, southern Oklahoma — 22nd Annual Highway Geology Symposium, Norman, Okla., 1971, Field-trip guidebook: [Norman, Okla.] Oklahoma State Highway Dept. and Oklahoma Geol. Survey, 31 p., illus., 1971.

Following the new I-35 and parts of the essentially parallel older U.S. 77, this trip traverses 500 to 1,000 feet of Permian shales and sandstones of the Central Redbed Plains to the Arbuckle Mountains in an area of gently rolling hills of a triangular Paleozoic inlier of steeply dipping and vertical beds of limestone, dolomite, and some shale; the part visited, is a faulted anticline overturned north. Two stratigraphic sections summarize the general geology of the field trip region. Specific problems encountered in blasting 150-ft-deep cuts for new construction, seepage from sandy terraces overlying the Permian "redbed" shales in the north, and the instability of highly plastic shales in the Ardmore basin are discussed. At each stop correction methods are outlined to emphasize the engineering problems. — GDC

08716 **Johnson, Philip.** Application of surface pressure to assist water recharge into the Ogallala Formation, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 193-204, illus., 1970.

This paper presents information obtained during a series of field studies aimed at developing a technique for economically recharging water into the Ogallala Formation at high rates of flow, by application of pump pressure at the surface. It was found that wells used for such recharge required special well completion techniques. Sustained high flow rates may be obtained by surface pump pressure. Large volumes of water may be stored in dewatered zones of the aquifer and retained long enough to permit local usage. Costs of recharge are reasonable with modern pumping equipment. Rapid disposal of playa lake water permits maximum utilization of land for farming. — DBV

Johnson, Pratt H. *See* Martin, J. Roger. 01652

Johnson, Robert F. *See* White, W. S. 01849

02014 **Johnson, Stanley S.** Bouguer gravity in Virginia, 36°30′ to 39°30′ N.-78°00′ to 79°00′ W.: Virginia Div. Mineral Resources Rept. Inv. 27, 40 p., illus., 1971.

An area of approximately 9,900 sq mi in Virginia between long 78° and 79° W., was surveyed by gravimetric methods. Approximately 1,985 stations, utilizing established bench marks for control, were occupied. The reduced field data were computer-contoured. Lithologies in the area include igneous, metamorphic and sedimentary rocks

that are in the Piedmont, Blue Ridge and Valley and Ridge physiographic provinces. The three regional maps are indicative of a definite relation between contoured Bouguer values and rock types. Maximum positive values occurred over gabbroic rocks and are reflected as gravity highs. Steepest gradients are generally where the Catoctin Formation, predominantly a metamorphosed basalt, is present. Triassic basins generally do not show a noticeable anomalous field except near Farmville where lower gravity values are recorded and near Culpeper where higher values are related to diabase intrusives. — *from* Author's abstract

02018 **Johnson, Stanley S.; Huxsaw, Carol L.; Thomas, Dorothy R.** A computer-program system to grid and contour random data: Virginia Div. Mineral Resources Inf. Circ. 15, 38 p., illus., 1971.

Computer programs developed at the Computer-Science Center, University of Virginia, for the Virginia Division of Mineral Resources for use in the preparation of geophysical data in the form of contour maps are described. Card output from the Division's gravity reduction program is put in a form (REFORMAT), by a FORTRAN-IV program, suitable for use by a grid-generating program for random data points (GRID GENERATION). This output and some from the REFORMAT program are used by the CONTOUR program (ALGOL) to draw contour lines using an offline plotter. — EH

01633 **Johnson, Thomas C.; Breslau, Lloyd R.** Geological results of a wide angle reflection survey using sonobuoys in the southern Chukchi Sea: Marine Geology, v. 10, no. 4, p. 281-290, illus., table, 1971.

The results of six sonobuoy wide angle reflection profiles in the southern Chukchi Sea show that from 200 to 700 m of unconsolidated sediments with acoustic velocities less than 2 km/sec overlie 1-1.5 km of sandstones and shales with velocities in the range of 2.1-2.8 km/sec. A higher velocity formation of approximately 4 km/sec was found at two of the six stations. These results show that extensive deposition, as well as marine erosion, has played an important role in making the Chukchi Sea floor the flat feature that it is today. — Authors' abstract

Johnston, John E. *See* Grossling, Bernardo F. 08753

01829 **Jolly, Wayne T.** Zeolite and prehnite-pumpellyite facies in the Keweenawan basalts of northern Michigan [Pt.] 2, The role of volatiles [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 34, 1971.

01690 **Jones, Elmer E.; Jr.** Where does water quality improvement begin?: Ground Water, v. 9, no. 3, p. 24-28, illus., 1971.

Most ground-water aquifers have a multibarrier natural defense system, yet many domestic and farmstead wells are contaminated. In many cases the well itself is the path of entry for the contamination. Water quality improvement should begin with excluding water of undesirable quality from the source of supply. This ideal must be accepted by well drillers, water conditioning dealers, and county and state health departments before the home owner and farmer can profit from this ideal. — DBV

08711 **Jones, Ordie; Schneider, Arland D.** Comparison of methods for determining the specific yield of the Ogallala, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 118-130, illus., table, 1970.

Specific yields of the Ogallala aquifer determined by different methods are summarized. The effect of slow draining and slow filling of the Ogallala sands must be taken into account regardless of the method used. The specific yield at Bushland, Texas, is greater than 0.20 and is probably 0.22. The average specific yield determined by pump test was 0.15, which means that the actual specific yield may be 33-47 percent greater than the present estimate. It is possible that the estimated average specific yield of 0.15 is low, and that an estimate of 0.20 is justified. — DBV

Jones, Ordie R. *See* Aronovici, V. S. 08715

Jones, Ordie R. *See* Schneider, Arland D. 08717

08757 **Jones, Robert W.** Comparison of Columbia River Basalts and Snake Plains basalts, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 209-221, illus., 1970.

This paper discusses differences (in chemistry, petrography, color, texture, phenocryst mineralogy, field relations, stratigraphic relations, and flow characteristics) between the Columbia River Basalts and basalts of the Snake Plains. Differences between the Idaho Group and Snake River Group that may be used to tell the rocks of these two groups apart, in the same way that the Yakima Basalt and Picture Gorge Basalt of the Columbia River Basalt may be distinguished, are also discussed. — DBV

Jones, Stephen J. *See* Fisher, David A. 01618

01445 **Jones, Walter D.** Nondestructive water content determination: Geol. Soc. America Bull., v. 82, no. 5, p. 1377-1379, illus., 1971.

Accurate determination of dry-unit weights and shear strength in laboratory tests of compacted soil samples depends in large part on control of water content. Conventional water content determination destroys the structure of the sample. However, water content can be inferred with accuracy in many samples if the soil is packed into an internally insulated Harvard Miniature mold and the electrical resistivity of the sample is read. Resistivity determinations are reliable on the dry side of optimum but decrease in accuracy with increasing moisture on the wet side of optimum. — JHF

Judd, James B. *See* Heron, S. Duncan, Jr. 01463

01705 **Kachel, Nancy B.; Sternberg, Richard W.** Transport of bedload as ripples during an ebb current: Marine Geology, v. 10, no. 4, p. 229-244, illus., tables, 1971.

A large instrumented tripod was used in Puget Sound, to measure simultaneously currents within 1.5 m of the sea bed, and the changing ripple configuration of a sandy bottom. Measurement of heights and migration rates of ripples on time-lapse stereophotographs made it possible to calculate the amount of sediment moved. From the measured velocity profiles, the shear velocity and fluid power expended on on the bed were determined. These measurements of mass transport are compared with values predicted by several existing bedload transport theories. The authors' measurements indicate that K, a proportionality coefficient which supposedly reaches a constant maximum value for any system, increased exponentially with growth of the ripples, which were related to flow conditions. It appears that K does not reach a constant value in most marine environments but is related to sediment characteristics, shear stress, and turbulence of flow. — *from* Authors' abstract

01978 **Kaesler, Roger L.** Preliminary report — Morphological variation of *Ostracoda* from the Yankee Tank Creek drainage basin, Douglas County, Kansas: Kansas Geol. Survey Bull. 202, pt. 1, p. 5-7, illus., tables, 1971.

Thirty-three samples that contained ostracodes were collected by weekly sampling of each of nine ponds for a four-week period in June and July of 1969. Measurements of eight characters from the right valves of 317 specimens of *Cypridopsis vidua* were analyzed with a two-level nested analysis of variance. Statistically significant ($P < 0.001$) geographic variation was shown by all eight characters, whereas only one character showed significant temporal variation. Samples from ponds at higher elevations contributed most to the variation, and it is suggested that ponds with high elevations may have more heterogeneous environments. — Author's abstract

01892 **Kalder, Michael; Cazeau, Charles J.** Heavy minerals of Wando Bar and Sandy Island (Pleistocene), Georgetown County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 15, no. 2, p. 23-28, illus., 1971.

The objective of this investigation was to determine the nature of heavy mineral suites in the sands of these Pleistocene marine deposits and to compare them with nearby beaches. Neiheisel (1962) has indicated that in the Georgia Coastal Plain heavy mineral suites in Quaternary features became impoverished with increasing age. Samples from Wando Bar, Sandy Island, and a beach near Pawley's and North Islands were submitted to laboratory tests using a petrographic microscope with a mechanical stage, and the average percent of each heavy mineral was determined and tabulated, measuring discernible declines. Triangular scatter diagrams were plotted taking combinations of zircon, epidote, hornblende, and sillimanite. Hornblende and epidote are generally abundant in present beaches, but decline rapidly in older Quaternary deposits, probably because of climatic conditions. Zircon and sillimanite, more stable, are enriched by loss of unstable minerals, and may be of use in determining age of strandline deposits. — EHS

Kanasewich, E. R. *See* Agarwal, R. G. 02062

Karadi, Gabor. *See* Elnaggar, Hameed. 01788

01904 **Karup-Möller, S.** On some exsolved minerals in galena: Canadian Mineralogist, v. 10, pt. 5, p. 871-876, illus., tables, 1971.

Two new sulphides, mineral "A" ($Ag_2Cu_2Bi_6Pb_9S_{20.5}$) and mineral "B" ($Bi_2Cu_4Fe_5Pb_6S_{18.5}$) are present as exsolution minerals in galena from different deposits. Their fine grain size prevents a complete mineralogical study and no new mineral names have been proposed. The present study shows that bismuth- and/or silver-bearing galena cannot dissolve more than 0.5 percent copper at room temperature. At temperatures above 215°C and possibly as high as 400°C no more than an estimated 1 percent copper can dissolve in the galena structure. Therefore no solid solution series, similar to that between PbS and $AgBiS_2$, appears to be present between PbS and $CuBiS_2$. — Author's abstract

01607 **Keeble, A. B.** Freeze-thaw cycles and rock weathering in Alberta: Albertan Geographer, no. 7, p. 34-42, illus., table, 1971.

Results of laboratory experiments performed on 29 samples of various rock types from different areas of Alberta, some from bedrock and some from gravel, some weathered and some not, showed that the rock samples break down differentially when subjected to freeze-thaw action, depending on lithology and amount of previous chemical and mechanical weathering of the sample. The amount of freeze-thaw weathering has no apparent relation to porosity of the rock. The author concludes that many rock types found in Alberta are susceptible to freeze-thaw breakdown, especially in the south part of the province which has numerous freeze-thaw cycles a year, and that, therefore, freezing and thawing is probably the dominant type of mechanical weathering in this area. — EH

01579 **Keech, C. F.** Groundwater levels in Nebraska 1970: Nebraska Water Survey Paper, no. 28, 87 p., illus., table, 1971.

Results are reported of ground-water level measurements in 1970 in a network of observation wells in Nebraska. Results are compared with those from previous years to determined fluctuations in levels. Average levels in the fall of 1970 were lower than those a year earlier in 75 of the 93 counties of the state, due to less than normal precipitation. Data on water levels and departures from assumed normal and from the previous fall are tabulated for each county, and hydrographs are included for each well by county. — VSN

01613 **Keech, C. F.; Bentall, Ray.** Dunes on the plains — The Sand Hills region of Nebraska: Nebraska Univ. Conservation and Survey Div. Resource Rept. 4, 18 p., illus., 1971.

Natural resources are described of the Sand Hills region, an area of about 19,300 sq mi in north-central Nebraska which consists of sand dunes, stabilized by grass cover, with shallow lakes in the low-lying flats, and is drained by the Niobrara and Loup

Rivers. The dunes probably evolved in three episodes. In the first episode which may have begun in the early Wisconsin stage, the largest dunes were formed, some ten miles long and up to one mile wide, chiefly in the northwest. During the second episode medium-sized dunes were formed southeast of the large dunes. Small dunes superimposed on the other types are typical of the third episode. The Ogallala Formation of interlayered sediments, the younger alluvial deposits, and the basal sand dunes constitute a huge ground-water reservoir. Ground water and most stream water are of good quality. The development potential of the area is discussed. — EH

Kehrer, Harold H. *See* Toksöz, M. Nafi. 01776

Keil, Klaus. *See* Fodor, R. V. 01984

Keith, J. E. *See* Bogard, D. D. 01879

Kelley, William N., Jr. *See* Bonini, William E. 01937

01830 **Kellogg, Richard L.; Hinze, William J.** An aeromagnetic survey of the Southern Peninsula of Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 35, 1971.

Kennedy, George C. *See* Akella, Jagannadham. 01708

01796 **Kennedy, Michael P.; Moore, George W.** Stratigraphic relations of Upper Cretaceous and Eocene formations, San Diego coastal area, California: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 5, p. 709-722, illus., 1971.

Stratigraphic nomenclature for Upper Cretaceous and Eocene rocks in the San Diego area was completely revised on the basis of new stratigraphic relations established. The Upper Cretaceous Rosario Formation, redesignated as the Rosario Group, now includes the basal Lusardi Formation (previously named), the Point Loma (new name) and the Cabrillo (new name). The partly intertonguing La Jolla Formation (Eocene), redesignated the La Jolla Group, now includes eight formations — six have new names and two are former members. The Poway Conglomerate, formerly including all Eocene rocks above the La Jolla, is redesignated the Poway Group; the lower part consists of the Stadium Conglomerate (new name) and the overlying Mission Valley Formation (new name). — BHK

01717 **Kesling, Robert V.; Paul, Christopher R. C.** *Agostocrinus* and *Acolocrinus*, two new Ordovician crinoids with peculiar ray and respiratory structures: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 14, p. 221-237, illus., 1971.

Two new early Middle Ordovician disparate crinoids characterized by greatly reduced rays and unusual respiratory structures, of uncertain relation to each other and to other monocyclic inadunates, were collected from the Benbolt Formation at five localities in southwestern Virginia and northeastern Tennessee. In *Agostocrinus xenus*, n.gen., n.sp., the arms are wholly recumbent, clockwise, upon the RR and X, to which they are firmly attached, each PBr bearing a free upright pinnule; radial subsurface channels in the cup plates are presumably respiratory. In *Acolocrinus hydraulicus*, n.gen., n.sp., arms are absent and erect pinnules articulate directly with the sRR, which bear on inward shelflike projections ambulacral grooves convergent from the pinnules; serrate sutures along the cup plate junctions serve as adits to complicated system of subsurface canals and channels, which exit through an open pore on each iR-iR junction. — VMJ

01718 **Kesling, Robert V.** *Michiganaster inexpectatus*, a new many-armed starfish from the Middle Devonian Rogers City Limestone of Michigan: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 16, p. 247-262, illus., tables, 1971.

Michiganaster inexpectatus, n.gen., n.sp. (Paxillosida, Lepidasteridae), is the first echinoderm described from the Rogers City Limestone. Three specimens, one a juvenile, were found on one slab of limestone in a quarry near Rogers City, Mich. The new species is characterized by a very large elastic disk including elongate winged

and stellate plates, numerous short petaloid arms (perhaps 25 in adults), interambulacral areas bearing ossicles and plates, and long slender keeled mouth-angle plates. Free arms are bordered by conspicuous interomarginals, which alternate with thick oblong adambulacrals below and with wide superomarginals above. Preservation, associated fauna, and matrix lithology suggest that the starfish died in water of low salinity and reduced circulation, possibly in a marginal lagoon where they were entrapped. — *from* Author's abstract

01720 **Kesling, Robert V.** Two new crinoids of the family Scytalocrinidae from the Middle Devonian Silica Formation of northwestern Ohio: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 18, p. 283-289, illus., table, 1971.

Two new inadunate crinoids (Cladoidea, Dendrocrinoidea) are here added to the extensive echinoderm fauna of the Silica Formation; each is small and a single specimen. *Kophinocrinus magrumi* n.sp., the second described specimen of the genus, has a cup similar to that of the type species, *K. spiniferus* Goldring, 1954, except for shallower ornamentation and narrower X, and is the first to show the arms above the PBr_1 and the pinnules. The ten arms, extending nearly six times the height of the cup, branch from PBr_4, and the high-arched SBrBr bear alternate pinnules beginning on SBr_2, with each pinnule hinged on a small lateral flange set far down the side of the Br. *Decadocrinus wrightae silicaensis* n.subsp., differs from *D. wrightae* of the Arkona Shale in its smaller size and more elongate and slender BrBr; it may not be mature. — *from* Author's abstract

01436 **Keys, W. S.; Brown, R. F.** The use of well logging in recharge studies of the Ogallala Formation in west Texas, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B270-B277, illus., 1971.

As a part of a study of artificial recharge processes by the U.S. Geological Survey, a series of test holes was drilled in the Ogallala Formation in the southern High Plains of west Texas. Drive cores taken in each lithologic unit were analyzed for moisture content, specific retention, total porosity, specific yield, permeability, and grain-size distribution. Some of these parameters are correlated with neutron, natural gamma, and gamma-gamma geophysical logs. These correlations permit a better delineation of the hydrologic characteristics of the formation than had previously been possible. An apparent relation between ratios of naturally occurring radioisotopes and calcium carbonate may prove useful for detecting caliche in boreholes. — *from* Authors' abstract

08770 **Keys, W. S.; Brown, R. F.** The use of well logging in recharge studies of the Ogallala Formation, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 31-48, illus., 1970.

It is shown that geophysical logging (neutron, natural gamma, gamma-gamma, caliper) is most useful in investigating the feasibility of artificial recharge of the Ogallala aquifer. Logs can be used to extrapolate sample and test data laterally and vertically. They provide information not otherwise obtainable from cased irrigation wells, may enable the prediction of the yield or recharge potential of specific sections of the Ogallala, and may provide data for proper well construction. With a sufficient number of logs a more accurate lithofacies map of the aquifer could be constructed. Finally, borehole geophysics provides methods for in-place measurement of changes in the aquifer caused by artificial recharge. — DBV

02026 **Khelil, Chakib.** Analysis of errors in logging parameters and their effects on calculating water saturation, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. A1-A16, tables, 1971.

This paper focuses on the effects of errors in various logging parameters on the calculation of water saturation. Each parameter is investigated first separately and then collectively with others. Error in the saturation exponent has greatest effect, with clay content and clay resistivity in second place. Such an approach to estimation of the reliability of water saturation calculation is applicable as part of standard log

analysis whereever a detailed analysis is made on digitized logs or an overall estimate is sought. The mathematical basis for the approach is developed, and its application to a specific set of conditions is discussed to illustrate the step by step procedure to be followed. — DBV

Kidd, W. S. F. *See* Bird, John M. 01566

01569 **Kigoshi, Kunihiko.** Alpha-recoil thorium-234 — Dissolution into water and the uranium-234/uranium-238 disequilibrium in nature: Science, v. 173, no. 3991, p. 47-48, illus., table, 1971.

The rate of ejection of alpha-recoil thorium-234 into solution from the surface of zircon sand gives an alpha-recoil range of 550 angstroms. The alpha-recoil thorium-234 atoms ejected into the ground water may supply excess uranium-234. In pelagic sediments, ejected alpha-recoil thorium-234 may contribute to the supply of mobile uranium-234 in the sedimentary column. — Author's abstract

Kilgore, E. C. *See* Schmidt, A. W. 02042

01429 **Kimmel, G. E.** Water-level surfaces in the aquifers of western Long Island, New York, in 1959 and 1970, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B224-B228, illus., table, 1971.

During the period 1959-1970, ground-water levels in northwestern Nassau and east-central Queens Counties declined 20 to 25 feet. The magnitude and extent of the declines in the water table and in the Magothy potentiometric surface were roughly similar. The data suggest a high degree of hydraulic interconnection between the water table and the base of the Magothy aquifer, which includes from 200 to 1,100 feet of saturated unconsolidated deposits. The decline in water levels probably resulted from decreased recharge and increased pumping in an area of relatively low transmissivity. — Author's abstract

01649 **King, Chi-Yu.** Comments on paper by F. J. Centolanzi, "Maximum tektite size as limited by thermal stress and aerodynamic loads" [1969]: Jour. Geophys. Research, v. 76, no. 17, p. 4052-4053, 1971.

For the paper under discussion see ibid., v. 74, no. 27, p. 6723-6736, 1969; Abs. North American Geology, June 1970.

King, N. J. *See* VanLewen, M. C. 01765

01898 **Kingston, P. W.** On alloclasite, a Co-Fe sulpharsenide: Canadian Mineralogist, v. 10, pt. 5, p. 838-846, tables, 1971.

Alloclasite is a cobalt-iron sulpharsenide, and the idealized formula for material in one sample from the type locality is $(Co_{0.75}Fe_{0.25})As_{1.0}S_{1.0}$. The material in this sample is orthorhombic with the space group $P22_12_1$ and cell constants: a = 4.66A, b = 5.61A, and c = 3.40A; Z = 2. Electron microprobe analyses and powder diffraction data are given for three natural and two synthetic samples. — Author's abstract

Kipp, Nilva G. *See* Imbrie, John. 01886

Kirby, S. H. *See* Raleigh, C. B. 01876

01794 **Kirkland, D. W.; Gerhard, J. E.** Jurassic salt, central Gulf of Mexico, and its temporal relation to circum-Gulf evaporites: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 5, p. 680-686, illus., table, 1971.

A Late or Middle Jurassic palynomorph assemblage from the caprock of Challenger Knoll, central Gulf of Mexico, is dominated by species of *Exesipollenites*, *Spheripollenites*, and *Classopollis*, and was probably derived from underlying bedded halite known as Sigsbee salt. Circum-Gulf evaporite deposits such as the Louann-Werner of the southeastern United States, the Minas Viejas and the Salina of Mexico, and the Punta Alegre of Cuba probably correlate with the deep-lying Sigsbee salt. — BHK

Kittleman, Laurence R. *See* Randle, Keith. 01704

01560 **Kittrick, J. A.** Soil solution composition and stability of clay minerals: Soil Sci. Soc. America Proc., v. 35, no. 3, p. 450-454, illus., 1971.

Soil solution-soil mineral equilibria are described in terms of elementary chemical thermodynamics. Calculations are illustrated for Belle Fourche montmorillonite. Use of a graphical display of mineral stabilities to reveal the soil-solution basis of mineral weathering is also illustrated. — Soil Brief

01770 **Kiver, Eugene P.; Mumma, Martin D.** Summit firn caves, Mount Rainier, Washington: Science, v. 173, no. 3994, p. 320-322, illus., 1971.

Heat and steam from the crater fumaroles have melted over 7,000 feet (1735 meters) of cave passage in the ice-filled east crater of Mount Rainier. The caves are in approximate balance with the present geothermal heat release. Future changes in the thermal activity of the summit cone will cause corresponding changes in cave passage dimensions, location, and ceiling and wall ablation features. — Authors' abstract

08749 **Klapper, Gilbert; Berry, W. B. N.; Boucot, A. J.** Conodont correlations, *in* Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, p. 35-38, 1970.

Silurian conodont zonation is beginning to be of value for precise correlation in parts of eastern North America, as has been demonstrated by the work of Rexroad (this paper, p. 91-94). Correlations fall into a network of conodont zones established by Walliser (1962, 1964) primarily for central European sections. The zonal succession is based on the Cellon section in the Carnic Alps, where eleven conodont zones occur in a single sequence. Their relationship to Silurian reference sections where graptolite and brachiopod zones are well known must be clarified before standard Silurian subdivisions can be ascribed to the conodont zones with confidence. An important step in this direction has been taken in Bohemia. The detailed sampling that is necessary is discussed, with references to several instances of such correlation. — GDC

Klein Breteler, E. H. J. *See* Bakker, W. T. 01951

01831 **Klein, George deVries.** Precambrian clastic paleotidal sedimentation [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 36-38, 1971.

01887 **Kleinpell, Robert M.** California's early "oil bug" profession: Jour. West, v. 10, no. 1, p. 72-101, illus., 1971.

California has experienced three great bonanzas: gold mining, redwood lumbering, and oil. Important to the "black-gold" bonanza of oil were foraminifera, or "oil bugs," giving rise to the profession of paleontology. The history of this science and of some of the men who helped to develop it is reviewed, including its application to petroleum geology. Paleontology aids in correlation of strata in finding traps. Advances were also made in the field of evolution; a time-scale has been demonstrated as a point of reference; an increased knowledge of structure; and a panorama has been provided of the sequence of prehistoric climates and geographic settings. The future of professional geologists is discussed. — ESL

Klovan, J. E. *See* Hitchon, Brian. 02076

01872 **Koerperich, E. A.** A double-electrode method of spontaneous potential logging: Jour. Petroleum Technology, no. 11, p. 1437-1446, illus., 1970; Soc. Petroleum Engineers A.I.M.E. Trans. 1970, v. 249, p. 1437-1446, illus., 1971.

The double-electrode method of spontaneous potential logging provides a new means of determining permeable bed boundary locations and bed thickness. Wellbore spontaneous potential currents, flowing in the normal circuitous route circumscribing the shale-formation water-wellbore fluid contact, generally have maximum intensity in the wellbore adjacent to or very near the sand-shale boundary. The Delta

V curve reflects these points of maximum current intensity by exhibiting curve peaks of opposite polarity at upper and lower sand boundaries, the vertical distance between peaks being bed thickness. When using the Delta V curve in conjunction with the SP curve, the latter can be used for correlation, water resistivity calculations, and to provide a picture of sand-shale distribution. The Delta V curve may be useful in determining bed boundary locations and bed thicknesses (hence in sand counting) particularly when noise signals exist on the SP curve, and lends itself better to computerized sand counting than does the SP curve. — *from* Author's summary

Kohout, Douglas L. *See* Struble, Richard A. 01762

01932 **Kourt, Warren K.** Evaluation of mineral deposits during oil-well drilling: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 106-108, tables, 1971.

Many important discoveries of mineral deposits have been made as a result of routine exploration for oil and gas. Through the presentation of three hypothetical case histories, including cost data, the author shows how mineral evaluation can be performed during routine petroleum drilling operations and how mining companies and oil companies or oil operators can cooperate in such endeavors. — Author's abstract

Kozik, Harry G. *See* Ritch, Harlan J. 02044

01793 **Kraft, John C.; Sheridan, Robert E.; Maisano, Marilyn.** Time-stratigraphic units and petroleum entrapment models in Baltimore Canyon basin of Atlantic continental margin geosynclines: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 5, p. 658-679, illus., 1971.

The Baltimore Canyon basin, one of seven depocenters along the Atlantic continental margin, contains sediments comparable in thickness and age to those of the Gulf coast. Good reservoir conditions in onshore sediments indicate potentially productive offshore traps in marine sand pinchouts, channel sands, sedimentary wedges under unconformities, basement topography, and basement fault zones. Projected pinchouts, salt diapirs, linear basement ridges, and turbidite sand on continental slope-rise constitute additional trap possibilities. The wide variety of traps indicated should assure a high petroleum potential for the Atlantic continental shelf. — BHK

01591 **Kraus, Ernst C.** Die Driftbewegung der Arabische Halbinsel, verglichen mit der Erweiterung de Kalifornishen Golfes [The drift motion of the Arabian Peninsula compared with the widening of the Gulf of California (with English and French abstracts)]: Geol. Jahrb., v. 88, p. 595-610, illus., 1971.

With the example of the Gulf of Aden and the Californian Gulf, it was examined how lineaments of the "Mid-oceanic Medianzone" advance into a continent and subdivide it with their linear horizontal faults. Diagonal dilations allowed the magma, being under strong stress under the load of the crust, to well up. In the Californian graben and in the adjoining region of San Andreas there is no magma at the surface. The Gulf and the region of San Andreas were obviously not created by a primary uprising of the magma. There was no transverse dilation. It enlarged, however, the Aden Gulf and the Red Sea so that along the primary faulting the magma could well up. — Author's abstract

01698 **Krauskopf, Konrad B.** The source of ore metals: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 643-659, 1971.

An attempt is made to reconcile the widely held, strictly uniformitarian view that ordinary rocks are a sufficient source of metals in large ore deposits, given the right combination of ordinary geologic processes, and the opposing conclusion that metals must come largely out of the mantle, generally reached by those who meditate on the large-scale geographic distribution of ore deposits. The opposed points of view are reconciled by deriving ore metals ultimately from ordinary rock materials, but adding the postulate that these materials have undergone a sequence of igneous and sedimentary processes and in considerable part have been carried down in subduction zones to become part of the lower crust and upper mantle. It follows that ore deposits

should be most numerous in regions that have undergone much orogenic and igneous disturbance, that their geographic distribution is largely determined by events of the remote past and may now seem almost random, and that a given metal may form deposits of different ages in a single region. — DBV

Krizek, Raymond J. *See* Elnaggar, Hameed. 01788

Krouse, H. R. *See* Mitchell, R. H. 01700

Kullerud, G. *See* Craig, J. R. 02066

Kulp, Kenneth E. *See* Neuerburg, George J. 01931

01547 **Kuntz, Mel A.** Phase equilibria for students of igneous petrology: Jour. Geol. Education, v. 19, no. 3, p. 130-136, illus., 1971.

An understanding of phase equilibria in specific silicate systems and the application of experimental data has led to significant advances in knowledge of igneous processes. Important topics may be treated in a rigorous way in an introductory or first-year graduate petrology course. The principles of phase equilibrium in one, two, three, and four-component systems and pertinent petrologic examples of each type should be included in such a course. In addition, the application of experimental studies to the petrogenetic problems of various types of igneous rocks gives the student an appreciation of important aspects of igneous petrology. Three-dimensional scale models of phase equilibria in selected silicate systems can serve as useful instructional aids. Students find it easier to visualize and understand phase equilibria when depicted in well-labeled models. — Author's abstract

Kupfer, Donald H. *See* Louisiana State University. 08734

08736 **Kupfer, Donald H.** Mechanism of intrusion of Gulf Coast salt, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 25-66, illus., tables, 1970.

During the period 1925-40 the buoyancy origin of Gulf Coast salt domes was recognized and internal structure mapped. All salt is from a single formation, the Louann, up to 10,000 feet thick including associated sediments. Oil exploration interest centers on associated structures in the sediments, and emphasizes pulsating growth and domal migration. Within the salt the complexity of bedding, folding, shear zones, and inclusions stresses far-travel and salt-purification; especially in the southern domes. Linear orientations, triggering mechanisms, and geographic controls are vague. Gravity, heat, chemistry, and multispectral sensing should contribute to future knowledge. A mechanical intrusion model is presented that involves the basement, a sequence of stages, salt purification, multiple-folding, and recrystallization. — Author's abstract

01832 **LaBerge, Gene L.** Some geology of the Marathon County volcanic belt [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 39-40, 1971.

01703 **Lachenbruch, Arthur H.; Bunker, Carl M.** Vertical gradients of heat production in the continental crust — [Pt.] 2, Some estimates from borehole data: Jour. Geophys. Research, v. 76, no. 17, p. 3852-3860, illus., tables, 1971.

Vertical gradients of heat production were estimated from measurements on samples from 8 boreholes in granitic rocks. Samples contained from 10 to 100 specimens, and the borehole depths range from 350 m to 3 km. For holes less than 1 km deep the scatter of results is consistent with theoretical expectations based on known small-scale inhomogeneities. The uncertainty in gradient estimates from the deeper holes are not strongly influenced by such inhomogeneities, and cannot be evaluated statistically because of the possible effects of small perturbations of longer wavelength. The data suggest a general decrease in heat production with depth in the

granitic rocks of a magnitude consistent with the exponential source model. A 3-km hole in schist did not exhibit this trend, consistent with the view that upward concentration of sources occurred in the presence of a melted phase. Many more analyses will be needed to establish vertical heat-production trends with confidence. — *from* Authors' abstract

01749 **Lachenbruch, Arthur H.** Vertical gradients of heat production in the continental crust — [Pt.] 1, Theoretical detectability from near-surface measurements: Jour. Geophys. Research, v. 76, no. 17, p. 3842-3851, illus., table, 1971.

The linear relation between heat flow and heat production suggests that in a gross sense the vertical distribution of crustal heat production beneath granitic rocks has a simple generalized form. Attempts to determine a generalized vertical gradient from heat-production measurements from boreholes are complicated by inhomogeneities on all scales. Variations in heat production on the hand-sample scale preclude meaningful estimates of the generalized gradient in holes a few hundred meters deep. In holes 3 km deep, uncertainty due to small-scale perturbations is generally reduced to acceptable levels with 100 or so samples, but, perturbations with wavelengths greater than 1 km and amplitudes sufficiently small to permit the linear heat-flow relation, can still preclude meaningful estimates of gradient if the phase is unfavorable. Confident determinations of the trend of heat production with depth in granitic rock will require observations in several holes to depths of a few kilometers or in very large numbers of shell holes. — *from* Author's abstract

Laflamme, J. H. G. *See* Springer, G. 01902

Lamar, D. L. *See* Merifield, Paul M. 01475

01918 **Lammers, William Tuthill.** Insoluble material in natural water, Chap. 12 *in* Water and water pollution handbook, V. 2 (Leonard L. Ciaccio, editor): New York, Marcel Dekker, Inc., p. 593-638, illus., table, 1971.

This chapter discusses the physical, chemical and biological aspects of suspended and colloidal particles in natural water, which are related to the separation, concentration and analysis of such particles. Instruments, methods and calculations used in these fractionations and analyses are also described. — EH

Lancet, Kumiko. *See* Lancet, Michael S. 01985

01985 **Lancet, Michael S.; Lancet, Kumiko.** Cosmic-ray and gas-retention ages of the Chassigny meteorite: Meteoritics, v. 6, no. 2, p. 81-85, table, 1971.

The sole known chassignite, Chassigny, has a mean radiation age of 8.9 ± 0.5 m.y., rather typical for a stony meteorite. Its low Al-26 content (47.8 ± 4.4 dpm per kg) and high He-3:Ne-21 ratio (5.9) suggest that its preatmospheric size was not much greater than its recovered mass of 4 kg. Its K-Ar age is relatively short, 1.39 ± 0.17 AE, presumably due to a late outgassing event in its parent body. — Authors' abstract

Land, A. G. *See* Schmidt, A. W. 02042

Landis, E. R. *See* Dane, C. H. 01404

Landry, Stuart O. *See* Coates, Donald R. 01478

02049 **Langenheim, Jean H.; Bartlett, Alexandra.** Interpretation of pollen in amber from a study of pollen in present-day coniferous resin: Torrey Bot. Club Bull., v. 98, no. 3, p. 127-139, illus., tables, 1971.

Resin, collected from three kinds of conifers during 24 intervals in a year's period from a stand of mixed pine and hardwood, aided in reconstruction of ancient forests from the composition of pollen in amber. Viscosity and rapidity of hardening, varying with different taxa, were important in determining the surface area and length of time

that resin is receptive to pollen, so may influence the presence or quantity of pollen in amber. Kinds and relative amounts of pollen were not influenced by vegetation surrounding each tree, but reflected that of the entire study area. Oak and birch pollen were over-represented and pine, maple, and hickory were under-represented. While proportions of kinds of pollen do not give an accurate quantitative representation, they do indicate qualitatively the most common components. — *from* Authors' abstract

Langway, C. C., Jr. *See* Dansgaard, W. 08743

08722 **Langway, Chester C., Jr.** Stratigraphic analysis of a deep ice core from Greenland: Geol. Soc. America Spec. Paper 125, 186 p., illus., tables, 1970.

A 1957 drilling project at Site 2 on the Greenland ice sheet provided ice core to a depth of 411 m. Vertical variation in bulk density, macroscopic structure, oxygen isotope ratios, ionic constituents, and extraterrestrial dust (black spherules) was analyzed. Average total ionic concentration in the ice sheet ranges from 0.65 to 1.35 mg per liter. Annual global mass deposit of black spherules varies from 2.10×10^5 metric tons in 700-yr-old ice to 6.57×10^5 metric tons in 12-yr-old firn. Oxygen isotope ratio variation provides the best means of estimating accumulation at depth. Rates of net snow accumulation of 42.3, 34.2, 37.4, 41.1, and 41.6 g per cm^2-yr at the surface for A.D. 1954-57, c. 1773, c. 1513, c. 1233, and c. 934, respectively, are indicated. The core record shows that accumulation and temperature in 934 were similar to that of today, followed by a gradual decrease in both to a minimum in accumulation c. 1773 and an increase from 1773 to 1957 and following. — *from* Author's abstract

Larson, E. E. *See* York, D. 01605

01622 **Lasca, N. P.** River-ice fabrics — Preliminary results [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 151-152, illus., 1971.

Preliminary data [from the Plover River and Haymeadow Creek in northern Wisconsin] indicate that fabric is developed in river ice. Crystal orientations are usually subparallel to the ice surface, and develop partly in response to stress generated by stream flow. [The studies involve investigation of water and ice chemistry, channel development under winter ice cover, and river-ice crystal fabrics.] The *c*-axis of these river-ice crystals are usually flat-lying, or less commonly inclined as much as 30° from the vertical; in each case generally oriented perpendicular to river-flow direction. Later, crystals may be re-orientated in response to stress fields developed as winter piling occurs. — GDC

01439 **Laury, Robert L.** Stream bank failure and rotational slumping — Preservation and significance in the geologic record: Geol. Soc. America Bull., v. 82, no. 5, p. 1251-1266, illus., table, 1971.

Evidence of stream bank failure in the geologic record is surprisingly meager. Modern observations suggest that bank failures most likely to be preserved in the stratigraphic record are those produced by rotational slumping. Potential for preservation of these large-scale structures is greater along distributaries of deltaic plains and is apparently most easily accomplished by the type of rotational slumping in which base failure, rather than slope failure, is involved. Consequently, fossil displaced bank sediments are predictably rare due to the somewhat restricted environmental conditions under which they can be preserved best, the actual low frequency of bank failure within these environments, and possibly even lower frequency of true base failure in these same environments. — *from* Author's abstract

08729 **Lautsch, H.** Principles of the theoretical prediction of ground movements — Comparison with practical results and the task of the mining surveyor in the application of these predictions (with French summ.), *in* Canadian Symposium on Mining Surveying and Rock Deformation Measurements, 1st, Fredericton (New Brunswick), 1969, Proc.: Fredericton, Univ. of New Brunswick, p. 293-324, illus., 1970.

This paper discusses the principles of ground movements during and after the mining of a flat-lying seam. The limiting angle and crash angle of ground movements on the surface are described, together with the elements of ground movement: sinking, tilting, curvature displacement, stress, and pressure. The sphere of influence and reaction for the whole deposit, part of it, and the overlying beds, is discussed, together with the insufficiently filled-in mined area and its importance in ground movements. The theoretical principles involved are considered critically, with examples comparing practical results with theoretical predictions. Also treated are variations of the characteristics of ground movements in the case where several seams lying one above the other are mined and their importance in planning underground operations and constructing buildings at the surface. — DBV

02069 **Lee, L. Doyce.** A diabase dike in Meriwether County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 127, 1971.

Lee, S. Y. *See* Somasiri, S. 01562

Lee, W. John. *See* Westbrook, L. Paul. 02028

01815 **LeFeuvre, A. R.** Use of computer technology to develop mathematical models for natural bodies, Chap. 5 *in* Water and water pollution handbook, V. 1 (Leonard L. Ciaccio, editor): New York, Marcel Dekker, Inc., p. 263-295, illus., 1971.

Advantages and disadvantages of various mathematical models, computer technology techniques, and simulation of natural bodies of water, such as rivers, estuaries, basins and ground water, are discussed. Models of these bodies can be physical, pictorial or mathematical and must simulate both quantity and quality of water. Computerized solutions of mathematical models are given for some of these bodies of water. — EH

01786 **LeGrand, Harry E.; Stringfield, V. T.** Water levels in carbonate rock terranes: Ground Water, v. 9, no. 3, p. 4-10, illus., 1971.

Depth to the water table in carbonate rocks is controlled by local factors such as permeability and topography and by the regional factor of climate. Permeability and topography are dynamically developed according to the degree of preferential circulation of subsurface water and of solution; the water table correspondingly lies deep beneath hilly permeable karstlands and shallow beneath flat and poorly permeable rocks. Uneven distribution of permeability is responsible for disappearing and reappearing surface streams. Great infiltration capacities of some karst regions result in large local water table fluctuations, even to local water table fluctuations, even to local reversals of ground-water flow in wet and dry seasons. Water-level behavior in space and time is a primary consideration in interpreting the hydrology of carbonate terranes. — DBV

02048 **Leisman, Gilbert A.; Bucher, Jane L.** On *Palaeostachya decacnema* from the Middle Pennsylvanian of Kensas: Torry Bot. Club Bull., v. 98, no. 3, p. 140-144, illus., 1971.

Specimens of *Palaeostachya decacnema* from Kansas coal balls are described yielding new information on the structure of this cone. The cone axis has a solid pith and an aerenchymatous cortex. The stele can be either four- or five-lobed and the number of sporangiophores correspondingly eight or ten. Bract number is 14 or 16; none of the specimens exhibited 20 as in the syntypes. The anatomy of the bract is described and an emended diagnosis is presented. Variability seems to be a consistent characteristic of most calamite cones. — Authors' abstract

01953 **LeMéhauté, Bernard.** A comparison of fluvial and coastal similitude, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1077-1096 [1971].

A comparison of the conditions of similitude for movable bed scale models of rivers and estuaries on one hand, and beaches and shorelines on the other hand, is presented. It is demonstrated that despite the fact that the knowledge of sediment

transport by wave action is less advanced than in the case of steady current, the conditions of similitude for beaches are less stringent than for rivers. In particular, the effect of relative roughness is comparatively unimportant in the case of beaches, while the necessity of similitude of head loss imposes an imperative condition in the case of scale models of rivers. An introduction to a natural law of distortion for beaches is presented in analogy with the Lacey condition for rivers. — Author's abstract

Leveaux, J. *See* Poupon, Andre. 02033

Lewis, Charles F. *See* Gibson, Everett K., Jr. 01986

Lewis, Charles F. *See* Gooley, R. 01987

Lewis, Charles F. *See* Gibson, Everett K. 02057

Lewis, R. S. *See* Alexander, E. C., Jr. 01484

01965 **Li, Yuan-Hui; Tsui, Tien-Fung.** The solubility of CO_2 in water and sea water: Jour. Geophys. Research, v. 76, no. 18, p. 4203-4207, illus., tables, 1971.

It is shown that the solubility constant of CO_2 in water and NaCl solution determined by Bohr (1899) and in sea water by Krogh (1904) are essentially correct, and that Buch's (1951) estimate of its solubility in NaCl solution from Bohr's data is valid. — DBV

08746 **Libby, W. F.** Ruminations on radiocarbon dating, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 629-640, illus., tables, 1970.

The passage of 20 years has brought out clearly the essential features of the method, but some of the original assumptions need further thought. These assumptions were a) worldwide mixing within a few hundred years throughout the atmosphere and oceans, b) constancy of the ratio of the radiocarbon-production rate to the ocean depth, so that a single dating curve can be used worldwide, c) preservation of the original carbon in a form physically (and sometimes chemically) separable from the contamination from millenia of exposure, and, finally, d) that the routine measurements can be performed to the requisite accuracy of about 1 percent. All these assumptions seem to have been verified to varying extents. — Author's abstract

01456 **Lidiak, Edward G.** Buried Precambrian rocks of South Dakota: Geol. Soc. America Bull., v. 82, no. 5, p. 1411-1419, illus., table, 1971.

Early Precambrian granitic gneiss, mafic schist, and granite, outlined by prominent east-northeast-trending magnetic and gravity anomalies, are extensive in the buried basement of northeastern South Dakota, the southwesternmost extension of the Superior geological province. In central and western South Dakota equally prominent geophysical anomalies define the trend of middle Precambrian rocks. A middle Precambrian sedimentary succession in the Black Hills was deformed and intruded by granite approximately 1700 m.y. ago. Four distinct metamorphic belts which possibly date mainly from middle Precambrian time are recognized. A large granite terrane in southern South Dakota is tentatively interpreted as having formed 1430 to 1460 m.y. ago. The basement complex in southeastern and central South Dakota is overlain by a sheet of Sioux Quartzite, which is at least 1470 m.y. old. — *from* Author's abstract

01753 **Liebermann, Robert C.; Basham, P. W.** Excitation of surface waves by the Aleutian underground explosion Milrow (October 2, 1969): Jour. Geophys. Research, v. 76, no. 17, p. 4030-4034, illus., 1971.

The average surface-wave and body-wave magnitudes of Milrow are determined to be $M_s = 4.94$ and $m_b = 6.47$. Individual station magnitudes scatter by at least one unit about these averages. Milrow generated significantly smaller surface waves than

earthquakes of comparable m_b from the same geographical and tectonic region. These observations are consistent with those for the Aleutian underground explosion Longshot (October 29, 1965) and with similar M_s versus m_b studies in other regions of the world that use data from a large number of seismograph stations covering a wide range of azimuth and epicentral distance. — Authors' abstract

02065 **Linde, Alan T.; Sacks, I. Selwyn.** Errors in the spectral analysis of long-period seismic body waves: Jour. Geophys. Research, v. 76, no. 14, p. 3326-3336, illus., 1971.

Recent theories of earthquake radiation differ in their predictions as to behavior of the long-period part of the spectrum of radiated waves. A numerical model study shows that it is difficult experimentally to distinguish between these theories because of a fundamental difficulty in windowing seismic arrivals that consist essentially of a single cycle. The effect of noise in the record and of truncation due to later arrivals is to produce spuriously large amplitudes for the long-period part. These errors are amplified if corrections must be made for low instrumental magnifications at these periods. Analyses of records of many earthquakes by various techniques show that radiated body waves have a displacement amplitude spectrum characterized by a dominant period. This disagrees with theories that predict that long periods have a constant amplitude, and thus studies of the long-period spectrum interpreted in terms of these theories may yield results that are grossly in error. Experimental results are in agreement with Archambeau's theory, which predicts a dominant period. — *from* Authors' abstract

01702 **Lineback, J. A.; Gross, D. L.; Meyer, R. P.; Unger, W. L.** Studies of Lake Michigan bottom sediments — No. 8, High-resolution seismic profiles and gravity cores of sediments in southern Lake Michigan: Illinois Geol. Survey Environmental Geology Note 47, 41 p., illus., 1971.

Sedimentary units 1 ft or more thick were identified on high-resolution, sub-bottom, seismic reflection profiles taken in southern Lake Michigan along a 400-mi route in June 1970. Beneath the soft sediments that floor the lake, glacial till, and the irregular surface of underlying Paleozoic bedrock were clearly identified. Gravity cores taken along the track were used to correlate reflecting horizons and stratifications in sediments. Three main sedimentary units were recognized in most profiles: lacustrine clays (Lake Michigan Formation), glacial deposits (Equality(,) and Wedron Formations), and Paleozoic bedrock. Three sedimentation episodes in the Lake Michigan Formation were recognized, the oldest a sequence of reddish-brown clay (Sheboygan and South Haven Members) that is thickest in the northwestern part of the area and pinches out toward shore. The middle episode is represented by brownish-gray to gray, silty clay (Winnetka and Lake Forest Members) that pinches out shoreward and overlaps the lower unit. The youngest episode (Waukegan Member) is represented by dark-gray silt and silty clay that overlaps the lower unit. — *from* Authors' abstract

08763 **Lingenfelter, R. E.; Ramaty, R.** Astrophysical and geophysical variations in C-14 production, *in* Radiocarbon variations and absolute chronology — nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 513-535, discussion, p. 535-537, illus., tables, 1970.

Production rate of C-14 has been essentially constant for the last several millenia. A variety of phenomena cause changes in the rate, which may produce measurable perturbations in biospheric C-14 activity. This paper considers changes in C-14 production cased by variations in terrestrial and interplanetary magnetic fields, leading to changes in flux of galactic cosmic rays at the Earth, and by enhanced fluxes of particles produced by solar flares and by variations in local interstellar cosmic-ray flux produced by nearby supernova explosions. Using models of modulation of cosmic-ray spectrum by terrestrial and interplanetary magnetic fields, and of their possible time variations, resultant changes in C-14 production are computed. These changes are also calculated from estimates of rates of occurrence of solar flares and supernovae and their particle and radiation-flux densities at the Earth. Resultant changes in biospheric C-14 activity are calculated, using a simple, two-reservoir model for distribution of exchangeable carbon. — *from* Authors' abstract

Lipe, William D. *See* Coates, Donald R. 01478

01518 **Lipson, Herbert G.; Buckmelter, James R.; Fitzgerald, John J.** Comparison of optical fluorescence, electron microprobe, and neutron activation methods for chromium analysis in ruby, *in* Developments in applied spectroscopy, V. 9 (E. L. Grove; A. J. Perkins, editors): New York, London, Plenum Press, p. 437-448, illus., table, 1971.

Results of optical, electron microprobe, and neutron activation analysis methods for chromium determination in ruby are compared. Relative chromium concentrations down to the ppm range are determined optically in small sample volumes from intensities of R-line fluorescence exited with the 4880 A line of a cw argon gas laser. In conjunction with standards, concentrations close to the sample surface are obtained from electron microprobe measurements while bulk concentrations are determined from neutron activation analysis. In addition, local inhomogeneities are revealed by both optical and electron microprobe techniques. Advantages and limitations for each method with respect to standards, sensitivity, sampling and interference of other impurities are discussed. — Authors' abstract

Lipton, Stewart D. *See* Bubeck, Robert C. 01487

Liu, Olive. *See* Segesman, Francis. 02032

01809 **Lochman-Balk, Christina.** The Cambrian of the craton of the United States, *in* Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, p. 79-167, illus., 1971.

Cambrian deposits on the craton of the United States, which is bounded generally by the present 2,000-ft Cambrian isopach, are chiefly Upper Cambrian marine sediments underlain by Precambrian basement rocks. The Upper Cambrian sections average 300 m or less. Three major marine transgressions and regressions took place during Late Cambrian. Deposition was slow and much reworking occurred but there was no deep burial, structural deformation, or metamorphism on a regional scale. Deposits have been eroded at various times and erosion is continuing. Stratigraphic sections are grouped in four general regional provinces and the paleogeography and paleoecology, or environment of deposition, of each province is discussed. — EH

02043 **Lock, George A.; Hoyer, W. A.** Natural gamma-ray spectral logging [abs.], *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. AA1, 1971.

01780 **Lombard, S. M.; Marlow, K. W.; Tanner, James T.** The determination of antimony in standard rocks by instrumental neutron activation analysis [with French and German summaries]: Anal. Chim. Acta, v. 55, no. 1, p. 13-17, tables, 1971.

The abundance of antimony in the standard rocks G-1, W-1, G-2, BCR-1, AGV-1, PCC-1, DTS-1, GSP-1, SUL-1, SYE-1, BCR-2 and GR has been determined by instrumental neutron activation analysis. Comparison of the results of this work with those previously reported indicate that DTS-1 is the best choice as an antimony standard. Results for SYE-1, G-1 and AGV-1 indicate that these standards may not be sufficiently homogenous. — Authors' summary

Lomenick, T. F. *See* Bradshaw, R. L. 08739

Louage, Francis C. J. *See* Gabillard, Robert L. A. 02036

01833 **Lougheed, M. S.; Mancuso, J. J.** Hematite pseudomorphic after biogenic pyrite in the Negaunee Iron Formation [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 41, 1971.

08734 **Louisiana State University; Kupfer, Donald H.** (editor). Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, 192 p., illus., tables, discussion, 1970.

This symposium, under the auspices of the Department of Geology and the Institute for Saline Studies, was dedicated to Visiting Professor Richter-Bernburg, Vice-President of the Federal Geological Survey of the West German Republic, on the occasion of his one month visit as Lecturer to the L.S.U. Department of Geology. One of his lecture papers, and papers by L. I. Briggs and D. Z. Briggs, D. H. Kupfer, M. A. Dixon, A. J. Bodenlos, D. H. Eargle and E. R. Herbst, R. L. Bradshaw and T. F. Lomenick, W. C. Gussow, and J. D. Martinez are cited separately. — GDC

01900 **Louisnathan, S. John.** Refinement of the crystal structure of a natural gehlenite, $Ca_2Al(Al,Si)_2O_7$: Canadian Mineralogist, v. 10, pt. 5, p. 822-837, illus., tables, 1971.

The crystal structure of gehlenite, $Ca_2Al(Al,Si)_2O_7$, was refined to R' 3.7 percent from 3D diffractometer data. Silicon and aluminum show partial ordering with Al in tetrahedra at point $\bar{4}$, and $Al_{0.5}Si_{0.5}$ in tetrahedra at point symmetry m. Cross-hatched and lamellar structures observed in gehlenite, from Crestmore, Calif., are interpreted as twinning. Certain genetic aspects of such twinning are considered in terms of Al,Si ordering. — Author's abstract

01501 **Lövborg, Leif; Wollenberg, Harold; Sörensen, Poul; Hansen, John.** Field determination of uranium by gamma-ray spectrometry, exemplified by measurements in the Ilimaussaq alkaline intrusion, south Greenland: Econ. Geology, v. 66, no. 3, p. 368-384, illus., tables, 1971.

The abundance and distribution of U and Th in peralkaline rocks were determined from counts accumulated in the 1.76 and 2.62 MeV intervals of a portable gamma-ray spectrometer. Calibrations for U and Th were achieved by use of large concrete standards of known radioelement content, with a gamma-ray absorption nearly equal to that of the rock measured. Results confirmed that specific rock types have characteristic U and Th contents. Where adequate contrasts existed, contours of U and Th corresponded closely to rock type and followed structural trends in the rock. — *from* Authors' abstract

01878 **Lowrey, Barbara E.** Orbital evolution of Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4084-4089, illus., 1971.

The orbit of the Lost City meteorite is investigated to determine the influence of secular and encounter perturbations on the orbital evolution. Secular perturbations are negligible in the interval of 300-400 years and encounter perturbations are highly unlikely; therefore it is valid to interpret the short-lived cosmic radiogenic isotopes as having formed in the current orbit. During a 40,000-year numerical integration, the maximum inclination was 16°, the minimum 9.7°; the minimum eccentricity was 0.414, the maximum 0.447. Over a 500,000-year interval, it was found that the very long period secular terms were effective in preventing earth encounters for a substantial fraction of the time, suggesting that the hypothesis that the meteor was a surviving remnant of the early solar system ought not be completely dismissed. — Author's abstract

01426 **Luce, Robert W.** Identification of serpentine varieties by infrared absorption, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B199-B201, illus., tables, 1971.

The infrared spectra of 10 chemically and X-ray analyzed serpentines are presented with a tabulation of diagnostic absorption bands. The infrared absorption technique supplements X-ray diffraction for identification purposes. Each serpentine variety has a distinctive spectrum, but a mixture of chrysotile and lizardite cannot be characterized by this method. Serpentine can be distinguished from most common magnesium-rich minerals by spectral differences; however, when mixed with serpentine, minor amounts of brucite cannot be identified by infrared analysis. — Author's abstract

01941 **Luck, Günter.** Observation of sediment motion by underwater-television, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 687-708, illus. [1971].

For observation and interpretation of sedimentological movements an underwater-television set-up is employed, which is described in this paper. Results and experiences are exemplified. — Author's abstract

Luyendyk, Bruce P. *See* Uchupi, Elazar. 01795

01619 **Lyons, J. B.; Savin, S. M.; Tamburi, A. J.** Basement ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 93-100, illus., table, 1971.

Oxygen-isotope and chlorinity determination, as well as petrographic observations, indicate that the basement ice of the Ward Hunt Ice Shelf is largely composed of a unique brackish ice, which interdigitates with sea ice. Some iced firn occurs near the top of the basement ice, below an unconformity. Stratification in brackish and sea ice represents annual increments to the bottom of the ice shelf. The *c*-axis vertical orientation and small-angle grain-boundary relations in brackish ice are explained by nucleation and floating of ice dendrites from the under-cooled brackish water zone to the bottom of the ice shelf, where they attach themselves sub-parallel to the plane of the undersurface. Ice Island T-3 did not come from a break-up of the main part of the Ward Hunt Ice Shelf but probably originated in a nearby area to the west. — Authors abstract

01512 **Lyons, Paul C.; Wolfe, C. Wroe.** Correlation of granites by soda potash ratios: Geol. Soc. America Bull., v. 82, no. 7, p. 2023-2026, illus., table, 1971.

Correlation of granites which occur in separate plutons can be done using a chemical method of correlation by alkali feldspar soda/potash ratios. Granites from southeastern Massachusetts are used to illustrate the method.

01449 **Mabey, Don R.** Geophysical data relating to a possible Pleistocene overflow of Lake Bonneville at Gem Valley, southeastern Idaho, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B122-B127, illus., 1971.

Electrical resistivity soundings and aeromagnetic surveys in Gem Valley, Idaho, an area covered by Pleistocene basalt flows, indicate that prior to flooding by basalt, the south end was a topographic low and a broad channel along the west side reached north to Portneuf River canyon. The base of this channel is now about 5,100 feet above sea level, or slightly lower than the level of Lake Bonneville at the time of initial overflow at Red Rock Pass. Concealed topography beneath basalt suggests that drainage of the south end of the valley was, as now, south through Oneida Narrows into Lake Bonneville basin. If Oneida Narrows were open before Gem Valley was flooded by basalt, the low point in the rim of Lake Bonneville basin may have been at the head of Portneuf River canyon, with overflow through Portneuf River. Blocking of this drainage by basalt could have produced a rise in lake level and overflow at Red Rock Pass. — *from* Author's abstract

Maccini, John A. *See* Sweet, Walter C. 01545

08733 **Machairas, G.** La dalmatianite et son mode de formation dans la région de Noranda (Québec), *in* Problems of hydrothermal ore deposition; the origin, evolution and control of ore-forming fluids — Symposium, St. Andrews, Scotland, 1967: Stuttgart, Germany, E. Schweizerbart'sche Verlagsbuchhandlung (Internat. Union Geol. Sci., Ser. A, no. 2), p. 363-368, illus., table, 1970.

This assemblage of sericite, quartz, and chlorites is always found in hydrothermally altered rocks, characterized by oval and sometimes spherical grayish stains. In the Noranda region, its formation is tied to emplacement of massive sulfides of copper and zinc — principally chalcopyrite, pyrrhotite, sphalerite, pyrite, and secondary minerals. The assemblage appears in massive form and lenses along the boundary between rhyolites and andesites, or along the contact between rhyolites and rhyolitic breccias, now and then inside the latter. Rocks at the base of the deposits have undergone very strong transformation, limited in space by zones of halos or a funnel extending the halos in depth. The dalmatianite is found only in zones strongly altered by contact metamorphism, and appears to be the result of local metasomatosis by potas-

sic hydrothermal solutions under high temperature-pressure tied to rock porosity. — GDC

MacKenzie, Fred T. *See* Garrels, Robert M. 01870

01981 **Magnuson, Larry M.; Galle, O. Karmie.** Determination of suspended silica by atomic absorption: Kansas Geol. Survey Bull. 202, pt. 1, p. 17, 1971.

Described is a method for analyzing small quantities of suspended silica, either airborne or suspended in water. The silica is entrapped on a membrane. The membrane is ashed and the silica fused with Na_2CO_3 and dissolved in water. The quantity of silica is determined by atomic absorption. — Authors' abstract

01620 **Mahaney, William C.** Note on the "Arikaree stade" of the Rocky Mountains neoglacial [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 143-144, 1971.

Neoglacial deposits in the Indian Peaks section of the Colorado Front Range have been dated lichenometrically by recourse to a growth-rate curve developed for *Rhizocarpon geographicum*. The two glacial fluctuations of the Temple Lake (4,500-2,700 B.P.), and Gannett Peak (300-50 B.P.) have been recognized [in the Central Rocky Mountains (Richmond, 1965)] and "Arikaree" (1,900-1,000 B.P.) identified by Benedict (1968). Recent soil investigations on neoglacial deposits suggest the need to define an alternative type "Arikaree" in the Indian Peaks. — *from* Author's abstract

Maher, J. C. *See* Trollman, W. M. 01816

Maisano, Marilyn. *See* Kraft, John C. 01793

01585 **Malzell, Robert E.; Smith, Julian F.; Singer, T. E. R.** Abstracting scientific and technical literature: New York, Wiley-Interscience (John Wiley and Sons), 297 p., illus., 1971.

This book is an instruction manual for abstracting scientific and technological literature for the use of abstractors, scientists, or management personnel in universities, industry, business, and government, who write and use abstracts or are responsible for management of abstracting. It can be used effectively either as a text or for self-study. The text has 15 chapters as follows: introduction; user groups, clients, and audiences; managing abstracting operations; contents; selecting material; citing the reference; kinds of abstracts; abstract proper; special cases; providing access to abstracts — grouping and indexing; in-house abstracting bulletins; role of abstractor in literature searching; auxiliary services; bridging the time gap with abstracts; abstractor, computers, and information systems; evaluating abstractors and abstracting. — VSN

01685 **Makovsky, Leo E.; Waldstein, Peter; Edwards, William H.** Raman spectra of coals: Nature Phys. Sci., v. 231, no. 24, p. 154-155, illus., table, 1971.

This article reports Raman spectrums of unpolished chips and indicates some of the problems encountered, as well as the sort of information that might be made available by this method. The striking similarity between the spectrums of coal and carbon, reported by others, suggested an attempt to relate the relative intensities of two strong lines to the size of planar aromatic structures in coal; the results of this attempt indicate that the Raman lines of coal are composites. — DBV

01459 **Malahoff, A.; Hammond, S. R.** Sediment accumulation rates along the Murray Fracture Zone between 131° W. and 167° W. longitude: Geol. Soc. America Bull., v. 82, no. 5, p. 1429-1432, illus., 1971.

Seismic reflection studies along the Murray Fracture Zone between California and Hawaii show a thin sedimentary cover averaging about 50 m in thickness. Paleomagnetic stratigraphic analyses of sediments in cores taken in the region indicate a sediment accumulation rate of 1.3 mm/10^3 yrs for at least the past 0.69 m.y. — Authors' abstract

01473 **Malahoff, Alexander.** Magnetic lineations over the Line Islands Ridge: Geol. Soc. America Bull., v. 82, no. 7, p. 1977-1982, illus., 1971.

Aeromagnetic studies of the Line Islands Ridge between Kingman Reef and Christmas Island show a predominant magnetic lineation direction at 310° paralleling the strike of the ridge. On the average, the amplitude of the anomalies is less than 200 gammas, although the largest anomaly, observed over Kingman Reef, reaches 900 gammas peak to peak. The anomalies appear to have formed as the result of volcanic intrusions and extrusions during the formation and growth of the island ridge. — Author's abstract

01834 **Malan, Roger C.; Sterling, David A.** Distribution of uranium and thorium in Precambrian rocks of the western Great Lakes region [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 42-44, illus., 1971.

Mamet, B. L. *See* Armstrong, A. K. 01405

Mancuso, J. J. *See* Lougheed, M. S. 01833

01908 **Mandarino, J. A.** Memorial to Max Hans Frohberg [1901-1970]: Canadian Mineralogist, v. 10, pt. 5, p. 751-754, portrait, 1971.

01530 **Mandeville, J.-C.; Vedder, James F.** Microcraters formed in glass by low density projectiles: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 297-306, illus., tables, 1971.

Microcraters were produced in soda-lime glass by impact of low density projectiles of polystyrene ($\rho = 1.06$ g per cm^3) with masses between 0.7 and 62 picograms and velocities between 2 and 14 kmps. Morphology of the craters depends on velocity and angle of incidence of the projectiles. For normal incidence at 3 kmps the projectile leaves a dent; and between 3.5 and 4.6 kmps a continuous lip is formed. For velocities greater than 5.2 kmps at normal incidence an extensive spallation zone surrounds the central pit; the ratio of central pit diameter to projectile diameter (D_c per d) increases from 1.25 at 5.2 kmps to 1.75 at 14 kmps; and D_c per d is independent of projectile mass for constant velocity. Transitions in morphology of the craters formed by polystyrene spheres occurs at higher velocities than for more dense projectiles. For normal incidence the total displaced mass of the target material per unit of projectile kinetic energy increases with the kinetic energy of the projectile. — *from* Authors' abstract

Manuel, O. K. *See* Srinivasan, B. 01772

01441 **Map, Paul R.** Pattern of Triassic-Jurassic diabase dikes around the North Atlantic in the context of predrift position of the continents: Geol. Soc. America Bull., v. 82, no. 5, p. 1285-1291, illus., 1971.

When eastern North America, West Africa, and northeastern South America are reassembled in their relative positions in Triassic time, the dike pattern is radial and roughly convergent on the Blake Plateau and Bahama Platform. The pattern is ascribed to a stress field imposed on the continental crust at the onset of North Atlantic sea-floor spreading. — AG

01709 **Marchand, Denis E.** Rates and modes of denudation, White Mountains, eastern California: Am. Jour. Sci., v. 270, no. 2, p. 109-135, illus., tables, 1971.

Long-term total denudation rates, estimated from depths of removal beneath a 10.8 m.y.-old basalt, range from 1 to 3 cm per 1000 yr. Present rates of chemical denudation are 0.14 to 0.19 cm per 1000 yr in adamellite terrane, and 1.7 to 2.1 cm per 1000 yr in areas underlain by Reed Dolomite. These are much lower than those estimated from botanical evidence in the same area (LaMarche, 1968) but are consistent with erosion rates in the Sierra Nevada. Chemical denudation by plant uptake and litter erosion was evaluated and compared with removal in solution. Total amounts of biogeochemical erosion do not appear to be significant, but this process

may account for some part of the extraction of P and K, and is responsible for appreciable portions of Al, Fe, and Mn denudation. In stream waters draining dolomite, partial pressures of CO_2 exceed values for air and adamellite-derived waters by over an order of magnitude, ascribed to biological factors. — *from* Author's abstract

01738 **Marie, James R.** Ground-water resources of Avoyelles Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 15 (in cooperation with U.S. Geol. Survey), 70 p., illus., tables, 1971.

Rocks composing the fresh-water-bearing zone underlying Avoyelles Parish in east-central Louisiana, range in age from late Tertiary to Pleistocene. Upper Tertiary rocks form a southward-thickening wedge of interfingered continental and marine deposits. They are overlain by Quaternary alluvial deposits averaging 150 feet in thickness, whose average coefficients of permeability and transmissibility are 2,000 gpd per sq ft and 200,000 gpd per ft, respectively. Water from this aquifer is hard, and has a high iron content. The Tertiary aquifer system, from 20 to 80 feet thick, has average coefficients of permeability and transmissibility of 250 gpd per sq ft and 10,000 gpd per ft, respectively, in the eastern part of the parish, and of 800 gpd per sq ft and 65,000 gpd per ft, respectively, in the western past. Its water is soft, but in the southwest has too high a fluoride content for public use. Water levels in both aquifers are generally less than 50 feet below land surface and wells are the source of water for most uses.— *from* Author's abstract

01520 **Mark, D. M.** Trend surface analysis of radiocarbon ages of glaciomarine sediments: Albertan Geographer, no. 7, p. 50-51, illus., 1971.

Trend-surface analysis applied to radiocarbon ages of organic matter in Pleistocene glaciomarine clays can provide data on patterns of advance or retreat of a major ice front or lobe by producing lines of equal age of the glaciomarine drift left by the retreating ice front, and also on the direction of ice flow which is roughly at right angles to these hypothetical ice fronts. — EH

Mark, Robert K. *See* McKee, Edwin H. 01411

Marlow, K. W. *See* Lombard, S. M. 01780

01535 **Marr, John D.** Seismic stratigraphic exploration, Pt. 2: Geophysics, v. 36, no. 3, p. 533-553, illus., 1971.

Past seismic stratigraphic exploration capabilities, which found large amounts of oil with crude tools from 1938 to 1962, are illustrated by three additional case histories covering a contribution to the discovery of the only supergiant reef-type oil field in the United States, the discovery of a thin sand pinchout reservoir along a strand line, and an exploration method for the delineation of a barrier reef complex and the overlying compaction fold complex. Present and future seismic stratigraphic exploration capabilities will be presented in the next part of this work. — DBV

01854 **Marsden, R. W.** Mesabi Range magnetite taconite, *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 128-140, illus., table, 1971.

Field Trip C starts at the Auburn mine in Virginia, Minn., and proceeds to the Erie mine near Aurora, the Reserve mine at Babbitt, and ends at the Dunka pit at the east end of the Range. The metamorphic changes in the Biwabik Iron-Formation caused by intrusion of the Duluth Complex, can be traced. The stratigraphic sequence in the Biwabik is seen in the open-pit Auburn mine; and the contact of the Duluth Complex with the upper Biwabik is seen in the Dunka pit. The resulting taconite is composed principally of quartz, magnetite, hedenbergite, and fayalite. — ESL

01652 **Martin, J. Roger; Nance, Weldon B.; Johnson, Pratt H.** Chemical and mineral composition of the Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4121-4123, illus., table, 1971.

The Lost City meteorite was analyzed by X-ray diffraction and optical emission spectrographic techniques. The major-element data combined with the olivine composition (fayalite 18.1 percent) and the concentrations of kamacite (17 percent) provide enough information to place the Lost City meteorite in the H chemical group. The X-ray diffraction scans indicate the meteorite probably belongs to the 5 petrologic group. — Authors' abstract

01865 **Martinez, Joseph D.** Environmental significance of salt: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 810-825, illus., 1971.

The saline waters of the oceans and salt deposits of the continents are an integral part of our ecologic system. This saline environment presents problems (such as disposal of large quantities of common salt), but opportunities as well, in man's attempts to utilize, change, and enhance his environment. — HWR

08735 **Martinez, Joseph D.** Technology of Gulf Coast salt, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 149-159, illus., tables, 1970.

Salt occurs in three forms in the Gulf Coast in sufficient abundance and availability to be of technological importance: salt domes and anticlines, sea water, and subsurface brines. Currently applied technology consists of dry salt mining, solution mining, liquified petroleum gas storage in domes, and desalination. Future technology may involve other uses for man-made solution caverns in salt domes. Current and future hydrologic developments in the realm of subsurface saline waters include: control of salt waters intrusion, utilization of highly saline waters, and storage of fresh water in saline water aquifers. Hydrocarbon production and sulfur mining are activities closely allied to salt technology. Solution mining of salt is of special importance and particular attention should be given to techniques employed, new uses for evacuated caverns, and prevention of structural failure. — *from* Author's abstract

Martinsson, Anders. *See* Berdan, Jean M. 08760

01983 **Mason, Brian.** The carbonaceous chondrites — A selective review: Meteoritics, v. 6, no. 2, p. 59-70, tables, 1971.

The presently known carbonaceous chondrites are listed, and their densities and contents of Fe, Si, and Mg recorded. A review of classification schemes indicates that Wiik's (1956) division into Types I, II, and III reflects basic differences in chemical and mineralogical composition and structure, and is preferable to the Van Schmus-Wood (1967) classification into C1, C2, C3, and C4 types. Renazzo is a Type II meteorite. The Van Schmus division of Type III meteorites into two subtypes is sustained, and is shown to involve not only textural differences but also differences in total iron content. The genesis of the different types of carbonaceous chondrites is ascribed to condensation in different temperature regions within the early solar nebula. — Author's abstract

Massey, G. R. *See* Timur, A. 02082

Mathieu, Guy. *See* Hunkins, Kenneth. 02005

Matondang, Sahat. *See* Barnhisel, R. I. 01561

Matthews, Robert A. *See* Burnett, John L. 01728

01835 **Mattis, Allen F.** Lower Keweenawan sediments of the Lake Superior region [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 45-46, 1971.

01583 **Maxwell, R. A.; Thomsen, W.; Wilson, F.** The seismic and geological definition of a reef: Shale Shaker, v. 21, no. 7, p. 152-157, illus., 1971.

This article describes an environmental exploration study of the Wellman oil field on the southwest side of the Horseshoe atoll reef complex in western Texas. The geologic history of the atoll area from early Pennsylvanian to early Permian time is given and a regional stratigraphic section included. From internal velocity data obtained by the Vibroseis and other techniques it was possible to outline the reef and to determine its seismic character and also to build a 3-dimensional model of it from the seismic cross section. Such a model is of value in searching for other reefs by seismic methods. — EH

May, Irving. *See* Ingram, Blanche L. 01421

01472 **Mazzulo, S. J.** Storm rollers: Geol. Soc. America Bull., v. 82, no. 7, p. 1973-1976, illus., 1971.

Scour marks formed by storm rollers were observed on Fire Island, New York. The eventual movement of storm rollers onto the beach and the resulting formation of scour marks are attributed to storm-generated currents and waves. The comparison of these features to similar ones from sediments of the Middle Devonian Hamilton Formation indicates that two types of scour marks may form from storm rollers, depending upon their site of formation. — Author's abstract

02027 **McCall, Charles; VonGonton, W. D.; Osoba, J. S.** The effect of hydrocarbons on the SP opposite sands, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. C1-C20, illus., tables, 1971.

A laboratory investigation was made to study the effect of hydrobarbon saturation on the SP across samples from 11 different sandstone formations, for a wide range of hydrocarbon saturations of each. In all, the presence of hydrocarbon shifted the SP toward the shale potential, and the shift was most pronounced at highest saturation. It was also observed that hydrocarbon had a greater effect on the potential across shaly than across clean sands. A plot of capillary pressure and a plot of SP versus hydrocarbon saturation were found to be similar. — DBV

01623 **McCann, S. B.; Hannell, F. G.** Depth of the "frost table" on Arctic beaches, Cornwallis and Devon Islands, N.W.T., Canada: Jour. Glaciology, v. 10, no. 58, p. 155-157, illus., table, 1971.

Although unlikely that permafrost extends far offshore, permanently frozen ground occurs at shallow depths below the intertidal zone of Arctic beaches. On gravel beaches of southern Cornwallis and Devon Islands in the Canadian Arctic Archipelago, depth of the active layer down to the frost table in the contemporary beach zone reaches a maximum of 50-60 cm in mid- to late August. In the table of data collected over three summer field seasons at Allen Bay, Cape Ricketts, and Radstock Bay, frost-table depths were determined by hand augering along profile lines from lowest raised beaches to intertidal zone. Data reveal a progressive increase in depth of the active layer from 0.25 m in late June to 0.60 m in late August, but no significant increase in depth seawards across the intertidal zone. A high-tide thermocouplet rod in Radstock Bay beach obtained five sets of sub-surface temperatures down to 1 m before storm waves smashed it. — GDC

McCasland, Willard. *See* Johnson, Kenneth S. 01885

08709 **McClain, Thomas J.; Jenkins, Edward D.** Digital simulation of the Ogallala aquifer in Sherman County, northwestern Kansas, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 72-88, illus., tables, 1970.

The 340-sq-mi area selected for digital simulation has 253 irrigation, 4 industrial, and 7 municipal wells obtaining water from the Ogallala aquifer. Pumpage from 1966 to 1969 was computed for each well from municipal and company records. Average aquifer coefficients were determined from measurements at selected wells. A digital computer model was used to simulate inflow, outflow, water levels, recharge, trans-

missivity, storage coefficient, saturated thickness, and pumpage. After the model was tested and found to be compatible with field conditions, it was programmed to define the effects of future development (1970-89). Water-level declines related to time and rate of pumpage illustrate the results of the simulation. — DBV

McCutcheon, Thomas E. *See* Baughman, Wilbur T. 01769

01689 **McDermott, James H.** The home ground-water supply picture as we see it: Ground Water, v. 9, no. 3, p. 17-23, illus., tables, 1971.

Drinking water for more than 50 million Americans comes from individual wells, springs, rain-water catchments, or unprotected surface water sources. A systematic survey of individual water supplies in four counties in Georgia in the summer of 1969 revealed that more than a third of the water supplies sampled are potentially hazardous to the users, and that the nature of the contamination is definitely related to the geologic environment and type of water supply. — DBV

02089 **McDonald, Barrie C.** Late Quaternary stratigraphy and deglaciation in eastern Canada, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 331-353, illus., tables, 1971.

Stratigraphic and radiocarbon data from four "control areas" have been used to reconstruct areal extent and succession of Wisconsin glacial phases and interstades between Quebec and Manitoba. Three important Wisconsin glacial phases are represented, separated by the early Wisconsin St. Pierre interstade and mid-Wisconsin Port Talbot interstade. Limits of glacier retreat during the St. Pierre and Port Talbot are postulated. Influence of the earliest Wisconsin glacial phase was concentrated in eastern Canada and did not extend west to Manitoba. Both post-Pierre glacial phases were more extensive than the earliest Wisconsin episode, and affected areas farther west. Evidence of ice flow directions between Manitoba and Quebec indicate that the Port Talbot interstade was accompanied by a westward shift of centers of glacier outflow. Some characteristics of late Wisconsin deglaciation are discussed. — *from* Author's summary

01683 **McDougall, Ian.** Volcanic island chains and sea floor spreading: Nature Phys. Sci., v. 231, no. 24, p. 141-144, illus., table, 1971.

Migration of the center of volcanism in the Hawaiian Island chain toward the East Pacific Rise with time is accounted for by a model which suggests that counterflow of material in the asthenosphere toward the Rise takes place in a zone which is of comparable thickness to that of the lithospheric plate. — Author's abstract

01492 **McDowall, R. M.** Oceanic islands and endemism — Further comment [to reply by J. C. Briggs (1969) to discussion by McDowall (1968) of Brigg's 1966 paper]: Systematic Zoology, v. 20, no. ½, p. 109-111, 1971.

The original paper was published ibid., v. 15, no. 2, p. 153-163, 1966; discussion, ibid., v. 17, no. 3, p. 346-350, 1968; reply, ibid., v. 18, no. 1, p. 145-148, 1969; *see* Abs. North American Geology, Jan. 1967, Dec. 1969, Dec. 1969, respectively. — VMJ

08705 **McGovern, Harold E.** Geology and ground water in the Ogallala Formation and undifferentiated Pleistocene deposits, southwestern Kansas, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 15-29, illus., 1970.

Major erosion of the Ogallala Formation and deposition of undifferentiated Pleistocene deposits have created a ground-water reservoir in southwestern Kansas that is unique to the High Plains area. The sequence of geomorphic events, which is outlined, is reflected in the variety of unconfined and semiconfined conditions within the ground-water reservoir; the former conditions generally exist in the upper materials and the latter in the lower. Water levels are declining as a result of pumpage from

more than 5,000 irrigation wells. Areas of great saturated thickness and intensive development show significant declines in artesian pressure but well yields remain undiminished. — DBV

01654 **McCrosky, R. E.; Posen, A.; Schwartz, G.; Shao, C.-Y.** Lost City meteorite — Its recovery and a comparison with other fireballs: Jour. Geophys. Research, v. 76, no. 17, p. 4090-4108, illus., table, 1971.

Photometric and trajectory data for the Lost City meteor and for a subsequent meteor (no. 40617) with similar flight characteristics are used to establish a preliminary calibration of the mass scale of other fireballs. There is excellent agreement between the photometric masses derived from the most recent determination of the luminous efficiency of the meteoric process and the dynamic masses determined from the trajectory and the shape of the recovered meteorite. Previous values for meteoroid bulk densities may have been underestimated by a factor of 5 or 8 if the flattened shape observed for Lost City and inferred from 40617 is common. However, meteor no. 40503, nearly 100 times the intensity of Lost City, reached maximum light and then was extinguished nearly instaneously; it was a different kind of meteoroid, its behavior not yet explained. — DBV

01411 **McKee, Edwin H.; Mark, Robert K.** Strontium isotopic composition of two basalts representative of the southern Snake River volcanic province, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B92-B95, illus., table, 1971.

The isotopic ratios Sr-87/Sr-86 from two samples of Pliocene olivine basalt from north-central Nevada are 0.7056 and 0.7058. These values are similar to those from Snake River Plain basalts and other upper Cenozoic basalts in north-central Nevada and support field evidence that the Snake River volcanic province extends about 100 miles, in a southerly direction, from Idaho into Nevada. These basalts have very similar bulk chemistry to ocean-ridge tholeiites but have Sr-87/Sr-86 values that indicate a significant enrichment in Sr-87 compared with ocean-ridge tholeiites. — Authors' abstract

01477 **McMaster, Robert L.** A transverse fault on the continental shelf off Rhode Island: Geol. Soc. America Bull., v. 82, no. 7, p. 2001-2004, 1971.

Continuous seismic profiling on the continental shelf off Rhode Island has revealed a fault that strikes north-south and dips to the east. The fault appears near Block Island, Rhode Island, and is traceable 60 km seaward. It is either middle to late Tertiary in age or perhaps was active from pre-Cretaceous to upper Tertiary time. No apparent relationship can be established with know mainland faults of southeastern Connecticut and southern Rhode Island and outer shelf structural features. — Author's abstract

01635 **McPherson, H. J.** Dissolved, suspended and bed load movement patterns in Two O'Clock Creek, Rocky Mountains, Canada, summer, 1969: Jour. Hydrology, v. 12, no. 3, p. 221-233, illus., tables, 1971.

During the summer of 1969, 12,850 tons of material were removed as suspended sediment load, 440 tons as dissolved load and 65 tons as bed load from Two O'Clock Creek Basin in the Canadian Rockies [Alberta]. This is equivalent to a surface lowering of the basin by 0.0195 inches per year, a figure which agrees very well with rates of denudation reported by researchers for other mountain areas. During the peak snow melt generated flood in early June, 87 percent of the total sediment load was exported. Most of the remainder was transported out of the basin by secondary high flow resulting from rainfall and snow melt in early July. The single most intense rainstorm of the season on August 5 and 6 resulted in a minor increase in stream flow but no increase in sediment discharge. — Author's abstract

01580 **McVicar, B. M.** Computer compatible techniques — The Holy Grails of logging: Canadian Petroleum, v. 12, no. 5, p. 26-30, illus., table, 1971.

Tools of data analysis include data screening; regression, canonical, variance, factor, Q Mode factor, or R mode factor analyses; discriminant function; spectrum analysis; convolution; correlation; simultaneous equation solution; and trend-surface analysis, or cluster analysis. Following a two-year survey of the status of the arts of digital well log and geologic computer analysis, a group sponsored applied research program was initiated in the Rainbow Lake area, Alberta. The Keg River section of key logs for a large number of wells was digitized and processed by a variety of the above tools; a library of over one million digital log samples was created and processed. Results (excellent, good, fair, etc.) are tabulated for each analytical technique and discussed briefly. Specific comments are made on various techniques which can provide improved vertical variables and mappable parameters. — VSN

01590 **Mellen, F. F.** What's ahead for the Black Warrior basin?: World Oil; v. 173, no. 2, p. 45-46, 53, table, 1971.

The Black Warrior basin of northern Mississippi and Alabama, considered an underdeveloped basin, has great oil and gas potential throughout its Paleozoic sediments which range in age from Pennsylvanian down to known Cambro-Ordovician and probably to Cambrian. Only fifteen exploratory tests have reached depths greater than 10,000 feet. The first deep Knox test (12,500 feet) is currently being drilled in Pickens County, Alabama, and in late June there was a shallow drilling play in Lamar County, Alabama — CWC

01968 **Menard, H. W.** The Late Cenozoic history of the Pacific and Indian Ocean basins, *in* The Late Cenozoic glacial ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 1-14, illus., 1971.

Marine geology guided by the paradigm of plate tectonics suggests that late Tertiary time has been marked by intense volcanism, continental drift, and vertical motion of continents and the sea floor. All these factors may have influenced the onset of glaciation. — Author's summary

01836 **Mengel, Joseph T., Jr.; Hendrickson, Ronald A.** Exploration geology of Douglas County, Wisconsin [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 47-49, 1971.

01475 **Merifield, Paul M.; Lamar, D. L.; Stout, M. L.** Geology of central San Clements Island, California: Geol. Soc. America Bull., v. 82, no. 7, p. 1989-1994, illus., 1971.

Central San Clemente Island is underlain primarily by nonmarine volcanic rocks. A 1,200-ft core hole, drilled near sea level on the west coast of the island, penetrated a homogeneous sequence of basaltic andesite flows varying in thickness from 11 to 169 feet. Whole-rock potassium-argon dates of samples taken near the top and bottom of the core hole indicate that the cored sequence was extruded in less than 1 m.y. during Miocene time. Unconformably overlying the andesitic flows are dacitic flows reaching a total thickness of about 300 feet. Miocene sediments and Quaternary beach sands overlie the volcanics. The Tertiary rocks are folded into a northwest-trending anticline. North-northeast to northeast-trending faults cut the Miocene rocks but do not displace the prominent surf-cut terraces. — *from* Authors' abstract

Merriam, D. F. *See* Robinson, J. E. 01668

02056 **Meyer, Charles, Jr.** An experimental approach to circumstellar condensation: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 551-565, illus., tables, 1971.

An experimental approach to the subject of circumstellar condensation of minerals has demonstrated that crystalline silicates can be condensed from a vapor under conditions present in circumstellar space. The results reported here support the hypothesis that the bulk chemistry of various meteorite classes may record the original fractional condensation of refractory oxides in the solar system. The direct synthesis of crystalline silicates by vapor condensation supports the hypothesis that carbonaceous meteorites may contain examples of minerals formed by direct circumstellar condensation. — DBV

Meyer, R. P. *See* Lineback, J. A. 01702

01677 **Meyerhoff, A. A.; Teichert, Curt.** Continental drift — [Pt.] 3, Late Paleozoic glacial centers and Devonian-Eocene coal distribution: Jour. Geology, v. 79, no. 3, p. 285-321, illus., 1971.

The presence of major late Paleozoic ice centers and of large Paleozoic coal fields in various places in the world suggests that popular reconstructions of Gondwanaland and Laurasia are wrong. The great amount of rain required for coal accumulations could not have been precipitated unless late Paleozoic Atlantic and Indian Oceans existed. The possibility that these late Paleozoic oceans were inland seas is eliminated by circulation requirements. Thus, until advocates of new global tectonics find an alternate explanation for tillite and coal distribution, the spreading sea-floor, mobile-plate, and polar-wandering hypotheses will have to be regarded as interesting speculations. — *from* Authors' abstract

02060 **Meyers, Phillip A.; Quinn, James G.** Fatty acid-clay mineral association in artificial and natural sea water solutions: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 628-632, illus., table, 1971.

An analytical method using gas liquid chromatography has been developed which provides a measure of the amount of fatty acid that can be associated with montmorillonite clay. Analysis of these acids associated with clay isolated from synthetic and natural sea water systems shows a direct relationship between the amount of acid removed from solution and its initial concentration. — Authors' abstract

01419 **Meyrowitz, Robert.** Chemical analysis of sphene — Spectrophotometric determination of silicon, aluminum, titanium, total iron, and phosphorus, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B165-B170, 1971.

Silicon, titanium, total iron, and phosphorus are directly determined spectrophotometrically in sphene, using molybdenum blue, hydrogen peroxide, 1, 10-phenanthroline, and heteropoly blue procedures, respectively. Aluminum is determined spectrophotometrically with pyrocatechol violet after separating titanium and iron by precipitation using cupferron. — Author's abstract

Michel, M. C. *See* Alexander, E. C., Jr. 01484

01917 **Michigan Basin Geological Society.** Annual Field Excursion, 1971 [Guidebook] — Geology of the Lake Erie Islands and adjacent shores: [East Lansing?, Mich.] Michigan Basin Geol. Soc., 63 p., illus., 1971.

Included in this Ohio excursion guidebook, with introduction and road log by Jane L. Forsyth, are three other papers of regional interest: Bedrock geology of Ottawa County, Ohio, by Dale R. Sparling; Preliminary report on the stratigraphy of Upper Silurian rocks of western Ohio, by A. Janssens; Silurian and Middle Devonian stratigraphy of the Michigan Basin — A view from the southwest flank, by Robert H. Shaver and others. Facing the first page is a stratigraphic section in the Erie Islands area; in appendix is a well-log section from Monclova Township, Lucas County. — GDC

01641 **Mickey, W. V.** Strong motion response spectra: Earthquake Notes, v. 42, no. 1, p. 5-8, tables, 1971.

Empirical equations derived from explosion data compare well with earthquake measurements. Maximum earth motion in cm, cm per sec, and gravity units, body-wave earthquake magnitude, and distance in km, are included in the functions: $a = 3.04 \times 10^{0.74m-4}R^{-1.4}$; $v = 4.06 \times 10^{0.88m-3}R^{-1.5}$; $d = 5.66 \times 10^{1.1m-5}R^{-1.30}$. — Author's abstract

Migdisov, A. A. *See* Ronov, A. B. 01671

01973 **Miller, D. N.** Integrated exploration economics in Wyoming — Viewpoint of a geologist: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 804-806, illus., 1971.

Integration of mining and petroleum interests in Wyoming has opened a new type of economic incentive. Geologists engaged in the activities must be knowledgeable in the broadest sense and administrators must rely on flexibility in corporate decisions. Collectively, the mineral industries are entering into new and more profitable types of investment programs as a result. — Author's conclusions

01992 **Millhollen, G. L.** Melting of nepheline syenite with H_2O and $H_2O + CO_2$, and the effect of dilution of the aqueous phase on the beginning of melting: Am. Jour. Sci., v. 270, no. 3, p. 244-254, illus., tables, 1971.

This study examines the effect of addition of a known amount of CO_2 to the aqueous phase on the beginning of melting of nepheline syenite and attempts to simulate natural conditions in which equilibrium water pressure is less than total pressure. Experimental techniques are described, data are tabulated, and curves derived from P-T projection of melting relations of the syenite are shown. Results show that composition of pore fluids greatly influences the temperature at which anatexis begins at a given pressure. If a H_2O-bearing magma encounters or a CO_2-rich pore fluid, H_2O will tend to diffuse out of the magma to reach equilibrium with the fluid, and the magma will tend to crystallize. Thus, reaction of magma with limestone would cause crystallization of the magma. Because of low permeability of rocks and slow diffusion of water in the magma, reaction between wall rock and magma would be in the immediate zone of contact. — VSN

Milliman, J. D. *See* Uchupi, Elazar. 01795

01488 **Milliman, John D.** The role of calcium carbonate in calcium carbonate in continental shelf sedimentation, *in* The *new* concepts of continental margin sedimentation, application to the geological record — AGI Short Course Lecture Notes, Houston, Tex., 1971, Suppl. (D. J. Stanley, editor): Washington, D.C., American Geological Institute, 20 p., illus., table, 1971.

A knowledge of shelf carbonates is important in understanding shelf sedimentation because it provides information on both environment and age of deposition. Distribution of calcium carbonate on continental shelves, carbonate components on continental shelves, inner and outer shelf sediments, the "algal ridge" system, shelf oolite, and age and alteration of shelf carbonates are discussed. The calcium carbonate content of any sediment is dependent on water temperature and rate of terrigenous sedimentation. When carbonate components from shelves throughout the world are compared, many similarities are found. The major differences between inner and outer shelf assemblages is in the relative abundance of benthonic and planktonic foraminifera. — ESL

Misk, A. *See* Poupon, A. 01764

01676 **Mitchell, Andrew H.; Reading, Harold G.** Evolution of island arcs: Jour. Geology, v. 79, no. 3, p. 253-284, illus., table, 1971.

Modern active island arcs consist of a volcanic ridge or arc and a submarine trench. Rocks fall into three groups, which can be interpreted in terms of plate tectonics and geologic processes: (1) volcanic arc deposits of undeformed subaerially erupted volcanics; block-faulted volcanic and volcaniclastic rocks, diorites, granites, and low-pressure/high-temperature metamorphics; (2) submarine trench deposits of thick successions of quartz-deficient turbidites and pelagic sediments, and high-pressure/low-temperature metamorphics and mélange deposits indicating a Benioff zone; (3) ocean-floor oceanic crustal rocks of tholeiitic lavas, spilites, gabbros, ultrabasics, and pelagic sediments and fine-grained turbidites rich in tholeiitic detritus. Most arcs have resulted from intermittent descent of lithosphere along older Benioff zones. Ancient arcs from the Ordovician are discussed. — *from* Authors' abstract

01700 **Mitchell, R. H.; Krouse, H. R.** Isotopic composition of sulphur in carbonatite at Mountain Pass, California: Nature Phys. Sci., v. 231, no. 25, p. 182, tables, 1971.

Galena from the Mountain Pass carbonatite has an unusual isotopic composition of $\delta S\text{-}34 = -16.1$ to -22.8 compared to other carbonatite sulfides and sulfides from igne-

ous rocks in general. The observed fractionation is attributed to unusual conditions of oxidation in the magma and relatively low temperature of deposition of the sulfides. Evidence for extreme oxidation conditions is the abundance of barite (15-50 percent) and paucity of sulfides in the carbonatite. Precipitation of barite would remove heavy sulfur from the magma and enrich late fractions in S-32; therefore, later barites would be enriched in S-32 relative to earlier. So far, however, data are insufficient to allow a correlation between isotopic composition and paragenesis. — DBV

02002 **Mogel, Theodor R.; Street, Robert L.; Perry, Byrne.** Computation of alongshore energy and littoral transport, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 899-917, illus., tables [1971].

This work encompasses a study of the littoral regime of a section of the coastline of the city and county of San Francisco, Calif. The study included complete refraction analyses of all applicable deep water wave directions and periods, determination of breaker locations, and a computation of alongshore energy and potential littoral transport for seven stations located offshore along the 30-ft depth contour. The waves are refracted from deep water locations to the shoreline using the Stanford Wave Refraction computer programs. Wave breaking is assumed to take place whenever the computed wave height exceeds 0.78 times the local water depth. The effect of limiting the refraction coefficient is explored, since the refraction theory fails along caustic curves and predicts unreasonably large values for the refraction coefficient. — *from* Authors' abstract

Mogridge, Geoffrey R. *See* Silvester, Richard. 01939

Moncure, R. W. *See* Harrison, W. 01955

Moore, Carleton B. *See* Cronin, John R. 01609

Moore, Carleton B. *See* Gibson, Everett K., Jr. 01986

Moore, Carleton B. *See* Gooley, R. 01987

Moore, Carleton B. *See* Gibson, Everett K. 02057

Moore, George W. *See* Kennedy, Michael P. 01796

01837 **Morey, G. B.** Revised Keweenawan subsurface stratigraphy, southeastern Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 50, 1971.

Morey, G. B. *See* Ojakangas, R. W. 01851

Morey, G. B. *See* Weiblen, Paul W. 01853

01759 **Morgenstein, Maury; Felsher, Murray.** The origin of manganese nodules — A combined theory with special reference to palagonitization: Pacific Sci., v. 25, no. 3, p. 301-307, illus., tables, 1971.

Manganese responsible for nodular development is derived from both oceans and continents, the bulk probably through continental weathering. Ferruginous compounds are incorporated into ocean-bottom sediment layers through submarine volcanism. Terrigenous manganese accretes by catalytic action, or possibly a redoxreaction, of iron and ferromanganiferous complexes at the sediment-water interface. This results in formation of manganese nodules. The rate of manganese accretion is partially dependent upon rate of diagenetic palagonitization. New measurements indicate linear manganese accretion rates range from 1.7 to 8.7 mm per 10^6 yr. Rates for volumetric accretion range from 110 to 1,300 mm^3 per 10^6 yr. Initial development proceeds at a rapid rate, subsequent accretion at a slower rate. Manganese nodules with centers other than volcanic debris may be formed as a result of related catalytic mechanisms. — *from* Authors' abstract

01760 **Morgenstein, Maury.** A study of growth morphologies of two deep-sea manganese meganodules: Pacific Sci., v. 25, no. 3, p. 308-312, illus., 1971.

This paper describes two shape and surface-texture categories for manganese meganodules collected near the Mid-Atlantic Ridge. Septarian concretionary features, such as manganite crack-filling, and concentric ring formation around a rock seed center are described. The first type is not reported in lacustrine sediments while the second type is found both in lacustrine and marine environments. — EH

Morozova, S. N. *See* Veber, V. V. 01723

Morrison, Michael F. *See* Northrop, John. 01651

Morton, D. M. *See* Baird, A. K. 01451

Morton, R. D. *See* Robinson, B. W. 02068

Morton, Robert B. *See* Irwin, James H. 08706

01838 **Mothersill, J. S.** Limnogeological studies of Thunder Bay, Lake Superior, Ontario [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 51-52, 1971.

Mountjoy, Eric W. *See* James, Noel P. 01479

Mountjoy, Wayne. *See* Dyni, John R. 01425

Mudrey, M. G. *See* Weiblen, Paul W. 01853

01839 **Mudrey, M. G., Jr.; Weiblen, P. W.** Reinvestigation of "red rocks" in the Pigeon Point area, Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 53, 1971.

01991 **Mueller, Robert F.** Oxidative capacity of magmatic components: Am. Jour. Sci., v. 270, no. 3, p. 236-243, illus., 1971.

The capacity of magmatic components such as dissolved or precipitated ferrous and ferric iron compounds and water to control oxygen fugacity of magmas is treated theoretically. Stoichiometric calculations indicate that in relatively anhydrous magmas, such as those of Skaergaard complex, the oxygen fugacity is determined by reaction of ferrous and ferric iron, if these are abundant relative to quantity of dissolved water. However, if the quantity of water is high relative to iron, as in calc-alkali batholiths, oxygen fugacity is likely to be determined by dissolved water of a given H_2O/H_2 ratio and by tendency of H_2O to react with the Si-O-Si bridges of the silicate melt. — *from* Author's abstract

01922 **Muller, J. E.; Atchison, M. E.** Geology, history and potential of Vancouver Island coal deposits: Canada Geol. Survey Paper 70-53, 50 p., illus., tables, 1971.

The economic coal deposits of Vancouver Island occur in the Late Cretaceous Nanaimo Group which rests unconformably on a basement of late Paleozoic to Jurassic volcanic, sedimentary, and intrusive rocks. Coal measures consist of four or five depositional cycles of clastic strata, each ranging from coarse clastic continental nearshore sediments at the bottom to fine-clastic marine sediments at the top. Commercial coal is found only in the Comox and Nanaimo Basins. Deposition of the coal occurred mainly in reed-moors existing in lagoons. In the Nanaimo field only the Wellington seam in the west and the Douglas seam in the east have been workable. Probable mineable reserves are virtually exhausted. In the Cumberland field Number One, Two and Four seams were mined most extensively, but rarely in overlapping areas. The Comox field still has coal reserves that could become economic in the future. — *from* Authors' abstract

Mumma, Martin D. *See* Kiver, Eugene P. 01770

Murgatroyd, P. N. *See* Burch, C. R. 01667

Murphy, M. A. *See* Berry, W. B. N. 01471

Murray, E. J. *See* Petruk, W. 01974

Murthy, V. Rama. *See* Hall, Henry T. 01643

01840 **Myers, Wallace Darwin, 2d.** The sedimentology and tectonic significance of the Bayfield Group, Wisconsin and Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 54-55, 1971.

Naeser, C. W. *See* Garlick, G. D. 01695

Nakanishi, Mikiye. *See* Gorman, George C. 01593

Nance, Weldon B. *See* Martin, J. Roger. 01652

01599 **Nash, J. Thomas; Theodore, Ted G.** Ore fluids in the porphyry copper deposit at Copper Canyon, Nevada: Econ. Geology, v. 66, no. 3, p. 385-399, illus., table, 1971.

The large, low-grade copper and gold deposit at Copper Canyon, Lander County, Nevada, formed in the contact metasomatic environment adjacent to a shallow Tertiary intrusion. Vein and disseminated sulfide minerals occur in Upper Cambrian Harmony and Middle Pennsylvanian Battle Formations. Studies of fluid inclusions in stages of vein quartz and in healed fractures through quartz phenocrysts and pebbles reveal very saline, somtimes Co_2-rich fluids in early and middle stages of mineralization. Ore fluid salinities during base metal mineralization were about 40 wt percent; temperatures were near 375°C. Circulation of this hot brine was restricted to an elongate highly fractured zone within 3,000 feet laterally of the intrusive. Later fluids were near 300°C, and had lower salinities in the range 12 to 1.2 wt percent. Smaller lode deposits 1 to 5 mi from the intrusion formed from low to moderate salinity fluids at 250 to 335°C. Formation at approximately 6,000 feet depth is suggested. — *from* Authors' abstract

01678 **National Research Council.** Priorities for space research 1971-1980: Washington, D.C., Natl. Acad. Sci., 147 p., illus., tables, 1971.

This report of a study on space science and earth observation priorities for the period 1971-80 recommends levels of effort and support to be allocated to National Aeronautics and Space Administration programs in planetary and space exploration, astronomy, gravitational and solar-terrestrial physics, and earth-environmental and life sciences. The status of previous studies is reviewed and reports and recommendations of the working group in each field are given. Planetary explorer missions are presented in order of priority. Recommended lunar programs include geochronology; geochemistry, mineralogy and petrology of lunar rocks and fines; regional geology; terrane analysis; and geophysics. In solar-terrestrial physics, studies of gravity, solar wind and the magnetosphere are recommended. Programs for earth environmental sciences include application of space techniques to hydrology, oceanography, the biosphere, and geology and geophysics of the Earth. — EH

01754 **Nava, David F.; Walter, Louis S.; Doan, Arthur S., Jr.** Chemistry and mineralogy of the Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4067-4071, illus., table, 1971.

The Lost City meteorite has been classified as a type H5 chondrite on the basis of its bulk chemical composition, its mineralogy, and its petrography. Chemical analyses were done on magnetic and nonmagnetic fractions, which were separately analyzed by a combination of atomic absorption and classical gravimetric, colorimetric, and titrametric procedures. Thin sections were examined microscopically and with the electron microprobe to complete the description and classification of the meteorite as an equilibrated olivine-bronzite chondrite. — Authors' abstract

01959 **Nayak, Irvathur Vasudeva.** Equilibrium profiles of model beaches, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1321-1340, illus. [1971].

The investigation reported herein covers two aspects of equilibrium profiles, namely, a) the criterion governing their type and b) their reflection characteristics. The problems are first analyzed from dimensional considerations and then studied experimentally in laboratory wave flumes using different sizes of quartz, ground walnut shell and ground plastic as movable bed material. Empirical relations between pertinent parameters governing the beach processes are given. — Author's abstract

Nelen, Joseph. *See* Clarke, Roy S., Jr. 01758

01502 **Netoff, Dennis Ivan.** Polygonal jointing in sandstone near Boulder, Colorado: Mtn. Geologist, v. 8, no. 1, p. 17-24, illus., 1971.

Polygonal joint patterns occur on sandstone outcrops near Boulder, Colo. Two types of polygonal patterns are recognized, large polygons with an abundance of right-angle joint intersections, and smaller polygons that are mainly hexagonal and pentagonal in form and have few right-angle intersections. Joints are shallow and are restricted to present-day outcrops. The geometry of the polygonal patterns suggests that shrinking is the cause of jointing. Shrinkage is believed to be produced by desiccation of montmorillonite-bearing sandstones. — Author's abstract

01931 **Neuerburg, George J.; Botinelly, Theodore; Kulp, Kenneth E.** Prospecting significance of hypogene iron oxide distributions in the Montezuma district, central Colorado: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 97-101, illus., 1971.

Distribution of hypogene iron oxides may be useful in prospecting the Montezuma district, central Colorado, for certain metals, some of which have not been mined or sought in the district. The depletion of accessory magnetite in fresh rocks of the Montezuma stock identifies sources or ore minerals for the pneumatolytic metals, locates probable areas of possible contact pneumatolytic deposits, and, in the altered rocks of the stock, identifies rock through which hydrothermal ore fluids have passed. Specularite veins are located in structures through which pneumatolytic ore fluids have passed. The presence of unusual amounts of vicarious metals such as bismuth, mercury, tin, and tungsten serves to identify magnetite and specularite that were involved in pneumatolytic ore process. — *from* Authors' abstract

01675 **Newton, J. G.; Hyde, L. W.** Sinkhole problem in and near Roberts Industrial Subdivision, Birmingham, Alabama — A reconnaissance: Alabama Geol. Survey Circ. 68, 42 p., illus., table, 1971.

More than 200 collapses and areas of subsidence formed in an area of less than half a sq mi from 1963 to 1970 in and near Roberts Industrial Subdivision in Birmingham, Ala. Water table lowering due to ground-water withdrawals makes the area prone to sinkhole development which will continue, barring recovery of the water table. Sinkholes are caused by collapse of cavities created in residual clay by "spalling" or downward migration of clay through openings in underlying carbonate rocks. Spalling and cavity formation are caused or accelerated by lowering of the water table resulting in loss of support to clay overlying openings in bedrock, fluctuation of the water table against the residual clay base, and increase in velocity of water in cones of depression to points of discharge. Collapse occurs when cavities progress upward until overlying clay cannot support itself or when vibration, shock, or loading over cavities jar the clay loose or force it down. — *from* Authors' abstract

01938 **Nichols, Maynard M.** Coastal processes from space photography, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 641-649, illus. [1971].

Photographs taken from space provide a new source of data concerning coastal processes. By utilizing the high vantage point and broad view, orbiting space cameras can record little known large-scale processes at short time intervals. Major outflow plumes, fresh-salt water "fronts," turbidity maxima and massive effluents are among the wide range of features displayed. It is shown from selected examples how coastal processes can be evaluated from space photography and how the information may be of use for solving certain problems as a supplement to field and other remote-sensing data. By 1972 satellite photography will be available on a routine basis for many

coasts of the world. Engineers are urged to consider the potential for improving their information which space photography has to offer. — Author's abstract

01895 **Nickel, E. H.; Webster, A. H.; Ripley, L. G.** Bond strengths in the disulphides of iron, cobalt, and nickel: Canadian Mineralogist, v. 10, pt. 5, p. 773-780, tables, 1971.

Microhardness values decrease in the sequence $FeS_2 > CoS_2 > NiS_2$. This is attributed to decreasing metal-sulphur bond strengths through the sequence. The decreasing metal-sulphur bond strengths which are attributed largely to ligand-field stabilization effects, are approximately balanced by increasing strength of the sulphur-sulphur bonds, so that the total cohesive energy remains relatively unchanged. — Authors' abstract

Nickel, E. H. *See* Faye, G. H. 01899

Nishi, Charles K. *See* Prokopovich, Nikola P. 01972

01648 **Noltimier, H. C.** Magnetic rock cylinders with negligible shape anistropy: Jour. Geophys. Research, v. 76, no. 17, p. 4035-4037, table, 1971.

It is shown theoretically that when the height-diameter ratio of rock cylinders is 0.865, the samples will exhibit only nondipole harmonics during measurement of remanence or low-field-induced magnetization if they have internal inhomogeneity or anisotropy. — DBV

01751 **Noltimier, H. C.** A model for grain dispersion and magnetic anisotropy in sedimentary rocks: Jour. Geophys. Research, v. 76, no. 17, p. 3990-4002, illus., 1971.

Susceptibility ellipsoids are derived for aggregates of small anisotropic magnetic grains dispersed thinly in a nonmagnetic matrix, given the individual grain susceptibilities. The statistical orientation of the magnetic grains is assumed to be represented by a Boltzmann distribution of their individual magnetic moments in thermal equilibrium with the earth's ambient magnetic field. Once equilibrium distribution is reached, the aggregate is assumed to be cemented, and the anisotropy of the aggregate is calculated from the susceptibility parallel to and perpendicular to the preferred direction. Two types of grains are considered, grains with prolate and oblate susceptibility ellipsoids. The aggregate susceptibility is found to be prolate with both types of grains. It is concluded that this should always be so unless factors other than thermodynamic equilibrium in the earth's field affect individual magnetic grains during accumulation and lithification of a sedimentary rock. — *from* Author's abstract

Normark, William R. *See* Piper, J. W. 01465

01563 **Norris, J. M.; Dale, M. B.** Transition matrix approach to numerical classification of soil profiles: Soil Sci. Soc. America Proc., v. 35, no. 3, p. 487-491, illus., tables, 1971.

In conventional classification of soil profiles the relative positions of pedogenic horizons within the profile are usually considered. In this paper numerical classification methods are described which consider the relative positions of samples in the profile. The methods are applied to 20 profiles, each determined on samples taken from 10 fixed depths. Results of these two numerical classifications are compared using an ordination procedure. Advantages and pedological applications of the mthods are discussed. — Authors' abstract

01430 **Norris, Stanley E.; Fidler, Richard E.** Availability of ground water from limestone and dolomite aquifers in northwest Ohio and its relation to geologic structure, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B229-B235, illus., 1971.

Potentially, the largest ground-water supplies in northwest Ohio are available from limestone and dolomite aquifers in a long, striplike area 7 to 18 mi wide that winds for many miles along flanks of the north-plunging Cincinnati arch, a structural fea-

ture of regional dimensions. Conditions conducive to high water yield are believed to have resulted from ground-water solution of rocks of the periodically emergent Cincinnati arch. Important in defining the regional ground-water system is a highly detailed geologic structure map, based on interpretation of geophysical logs, of the top of the Middle Silurian Lockport Dolomite, showing location of the arch in the 20-county study area. — *from* Authors' abstract

01811 **North, F. K.** The Cambrian of Canada and Alaska, *in* Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, p. 219-324, illus., tables, 1971.

In Canada, Cambrian rocks are exposed in Canadian Appalachia on the eastern margin of the Canadian Shield and in the Rocky Mountains, and in ranges north and west of them. The only proven Cambrian rocks in Alaska occur just west of the Yukon-Alaska boundary near 65° lat. The western development of the system, up to 1,150 km. wide, is occupied chiefly by cratonic facies, generally lacking Lower Cambrian. In the east development is discontinuous and only about 700 km wide. Outcrop areas are chiefly basinal facies with extremely narrow, or non-existent, cratonic facies in which Lower Cambrian predominates. Differences in the two sides of the shield are inherited from differences in the area in middle and late Paleozoic times. Faunal contrasts between eastern and western Canadian regimes, and boundaries of the Cambrian system are outlined. Areal descriptions of rock exposures are given. — *from* Author's abstract

01651 **Northrop, John; Morrison, Michael F.; Duennebier, Frederick K.** Reply [to comments by R. T. Haworth on "Seismic slip rate versus sea-floor spreading rate on the eastern Pacific rise and Pacific Antarctic ridge" (1970)]: Jour. Geophys. Research, v. 76, no. 17, p. 4049-4051, illus., 1971.

For the paper under discussion see ibid., v. 75, no. 17, p. 3285-3290, 1970; Abs. North American Geology, February 1971.

01779 **Norton, Elinor F.; Stoenner, R. W.** A neutron activation method for the determination of thorium in rocks and minerals using the 22-minute ^{233}Th activity [With French and German summaries]: Anal. Chim. Acta, v. 55, no. 1, p. 1-11, illus., tables, 1971.

A method is described for the determination of thorium in rocks and minerals which utilizes neutron activation, a radiochemical separation scheme and counting of the thorium-233 β-activity. A discussion is presented of various dissolution procedures used for silicate rocks with the conclusion that a potassium fluoride-pyrosulfate fusion is preferable to acid dissolution or sodium peroxide fusion or sinter. The sensitivity of the method is 10 ppb with a 100-mg sample. Results are given for the USGS standard rocks. — Authors' summary

01577 **Nriagu, J. O.; Anderson, G. M.** Stability of the lead(II) chloride complexes at elevated temperatures: Chem. Geology, v. 7, no. 3, p. 171-184, illus., tables, 1971.

Because of geochemical evidence indicating that many Mississippi Valley type deposits were precipitated from chloride-rich electrolyte solutions with total salt content ranging from 1-40 equivalent weight percent NaCl, attention has been drawn to the possibility that chloride complexing plays a very important role in the geochemical migration of ore metals. This report presents stoichiometric stability constants for stepwise formation of mononuclear lead chloride species, $PbCl_n^{2-n}$ ($n = 1$-4), calculated from isothermal saturation curves of $PbCl_2$ in three molal $Na(Cl, ClO_4)$ solutions. The constants at 28, 40, 60, and 90°C, respectively, are tabulated. The changes in enthalpy, entropy and heat capacity accompanying stepwise formation reactions have also been calculated from temperature coefficients of these constants. — GDC

01976 **Oakeshott, Gordon B.** (Compiler and editor). Origin and development of the state geological surveys: Jour. West, v. 10, no. 1, p. 133-162, illus., 1971.

This title includes not only the coverall paper but reports on six of the individual states: the Arizona Bureau of Mines by R. T. Moore, the California Geological Surveys and Notes on the Nevada Bureau of Mines by Oakeshott, Idaho's dual-purpose State Geologist by O. T. Hansen, the Oregon Dept. of Geology and Mineral Industries by J. E. Eliot and M. Roberts, and the Washington State Geologist by M. T. Huntting. The history of these surveys, beginning with New York in 1836, is traced. Twenty states east of the Mississippi organized surveys in the next few years, but all but three failed to survive the panic of the late 1830's and early 1840's. By 1900, however, 31 states east of the Mississippi had established surveys. The first survey established west of the Mississippi was in California in 1850. — ESL

02071 **O'Connell, Richard J.** Rheology of the mantle, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 140-142, 1971.

The main advances of the last four years in our understanding of mantle rheology have been in the realization that the lower mantle may be less resistant to creep than previously believed and in the realization and preliminary investigation of the complexities of the convection problem. This is a summary and bibliography of works by U.S. authors on theoretical and laboratory studies of creep; direct estimates of mantle rheology; and convection and large-scale flow. — DBV

01841 **O'Hara, Norbert W.; Hinze, William J.** Lake Michigan aeromagnetic survey [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 56, 1971.

01851 **Ojakangas, R. W.; Sims, P. K.; Morey, G. B.; Green, J. C.** Geology of the Vermilion metavolcanic-metasedimentary belt, northeastern Minnesota, *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 141-162, illus., geol. maps, 1971.

The metavolcanic and metasedimentary rocks were assigned to five formations by Morey and others (1970): Ely Greenstone, Lake Vermilion Formation, Sudan Iron-Formation, Knife Lake Group, and Newton Lake Formation. Five episodes of intrusive activity are recognized: synvolcanic bodies; lamprophyres and related hornblende-bearing rocks; plutonic rocks of Giants Range and Vermilion batholiths; altered diorite gabbro in post-tectonic dikes; and basalt, discontinuous dikes. Complex folding took place in the western part of the area, and high-angle faults break the sequence into a number of blocks or segments. Three generalized geologic maps of the Vermilion district are included. The road log for Trip D, the Vermilion district, comprises the last seven pages, and includes geologic notes for each stop, and sketches of folds. — ESL

01522 **Olafsson, P. G.; Bryan, A. M.** "Procedural activation energies" for the thermolysis reactions of crystalline amino acids by differential scanning calorimetry: Geochim. et Cosmochim. Acta, v. 35, no. 4, p. 327-336, illus., table, 1971.

The thermal decomposition of crystalline amino acids has been examined by a combination of Differential Scanning Calorimetry and Curve Resolution. Thermolysis pathways have been suggested for alanine, phenylalanine, serine and threonine in terms of the resolved thermograms. The resolved data have made it possible to calculate activation energies associated with each of the component reactions. The relative magnitudes of these E_A values have been rationalized in terms of associated structures. The thermal stabilities of the selected crystalline amino acids, in terms of the activation energy necessary for the initial decomposition step are as follows: alanine ≅ serine > phenylalanine > threonine. – Authors' abstract

01413 **Oldale, R. N.; Friedman, J. D.; Williams, R. S., Jr.** Changes in coastal morphology of Monomoy Island, Cape Cod, Massachusetts, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B101-B-107, illus., 1971.

Monomoy Island, an active spit undergoing short- and long-term changes in coastline, projects southward from the elbow of Cape Cod. Comparison of the 1969

shoreline with older shorelines, of as long ago as 1887, showed numerous changes in spit configuration. The north end of the island has been receding since 1948. If retreat continues at the current rate of about 40 feet per year, the island may separate into two parts in 70 or 80 years. Eastward progradation of the southern half has continued at a rate of about 40 feet per year since at least 1853. Present encroachment of the south end of the island into two deep basins to the southeast and southwest may result in major reduction in rate of southward progradation of the spit and may lead to increased erosion of the western shore. — *from* Authors' abstract

01862 **Oliver, W. B.** The geologists' role in evaluation economics: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 796-800, illus., 1971.

The systematic approach to evaluation economics in resource-based business ventures places the geologic function at the center of activity from discovery through development to depletion of a mineral prospect or deposit. Prospect analysis includes (1) definition of economic value; (2) preparation of comparative prospect ratings to establish priorities for development; (3) predevelopment evaluation of additional data required, cost estimates, and difficulties expected or encountered; (4) assessment of competitive position; and (5) continuous geologic input and feedback with communication of technical and economic data throughout the organization. — BHK

08754 **Olsson, Ingrid U.** (editor). Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969 Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, 652 p., illus., tables, 1970.

The Twelfth Nobel Symposium held August 11-15, 1969, at the University of Uppsala in Sweden was devoted to problems of radiocarbon dating and its geophysical implications and included 38 papers by chemists, physicists, geologists, dendrochronologists, archeologists, and geophysicists, 8 of which are cited separately here. The main object of the symposium was to discuss natural variations in the C-14:C-12 ratio in the atmosphere, how they could be determined, why they occur, and why they still exist. — EH

Omura, Akio. *See* James, Noel P. 01479

O'Neil, J. R. *See* Garlick, G. D. 01695

01692 **O'Neil, James R.; Barnes, Ivan.** C^{13} and O^{18} compositions in some fresh-water carbonates associated with ultramafic rocks and serpentinites, western United States: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 687-697, illus., tables, 1971.

All carbonates associated with the ultramafic rocks and serpentinites of the western United States are shown by their stable isotope ratios to be of near-surface, low-temperature origin. These include vein materials that have been previously classified as hydrothermal. New laboratory and natural data were obtained on the equilibrium isotope relations between hydromagnesite and water. The origins of travertines in the ultramafic areas are easily distinguished on the basis of their stable isotope ratios. The extremely heavy isotope ratios of nesquehonites suggest an intricate evaporating-film mechanism of formation. — Authors' abstract

O'Neil, James R. *See* Barnes, Ivan. 01784

Opdyke, Neil D. *See* Hunkins, Kenneth. 02005

Osoba, J. S. *See* McCall, Charles. 02027

08725 **Osvald, Hugo.** Vegetation and stratigraphy of peatlands in North America: Nova Acta Regiae Soc. Sci. Upsaliensis (Acta Univ. Upsaliensis), Ser. 5-C, v. 1, 96 p., illus., tables, 1970.

This investigation of the peatlands of the United States and Canada includes vegetation studies, cross-sections of peat strata and pollen analyses made by the author in

1927. A short survey of this material was published in 1928-1929, and papers on specific peat bogs appeared at various times between 1933 and 1955. This report, which includes the remainder of the material collected by the author, as well as a survey of the mires of North America, is a slightly revised and enlarged edition of his publications of 1928-1929, which were published in Swedish. — EH

02077 **Overton, Harold L.; Zeld, Marvin C.** A progress report on shale electric log, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. B1-B21, illus., table, 1971.

A complete electric log can be made from drill cuttings during drilling. The Na+ potential, resistivity of shale-water mix, and matrix resistivity all may be measured. The water filtered from shale may also be used to measure Ca++, K+, redox and cationic potentials. These are useful in determining limey sands and pressure caps, locating geopressured zones, and determining hydrocarbon environment. The pressure cap is a phase boundary. Highly reactive material is found in the zone below it, in which the shale matrix is very conductive and shale and sand water contents contrast radically. Ca++ tends to be in sands, fault zones, and caps; Na+ is about 5-10 times higher in sand; K+ is greater in shales. The water in shale cuttings turns from clear to dark brown as overpressure is penetrated. The thickness of caps and reduction in Na+ potential is functionally related to pressure gradient increase. — DBV

Owens, D. R. *See* Harris, D. C. 01907

Pakiser, Helen M. *See* Wolfe, Jack A. 01406

01808 **Palmer, Allison R.** The Cambrian of the Great Basin and adjacent areas, western United States, *in* Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, p. 1-78, illus., 1971.

In the Great Basin, which includes parts of western Utah, southeastern Idaho, southeastern California and most of Nevada, Cambrian rocks are exposed in many of the numerous north-south mountain ranges, in the Wasatch Mountains along the eastern margin of the basin, and in the lower part of the Grand Canyon. Cambrian sediments over 2,700 m thick, which covered the Great Basin and adjacent areas, were later disrupted by overthrusts, horizontal displacements, and intrusions. Environments ranged from near-shore in the eastern part of the area, across a complex of carbonate banks to deeper water sediments in the west. This study describes Cambrian rocks by geographic regions within two larger divisions, those east of and those within and west of the Sevier orogenic belt. Biostratigraphy and history, and mineral deposits of the Great Basin region are discussed. — EH

01810 **Palmer, Allison R.** The Cambrian of the Appalachian and eastern New England regions, eastern United States, *in* Lower Paleozoic rocks of the world — V. 1, Cambrian of the New World: London and New York, Wiley-Interscience, p. 169-217, illus., 1971.

The principal Cambrian exposures in the eastern United States, although few in number, occur in the Appalachian region, a 1,900-km belt up to 65 km wide which extends from the Canadian border to central Alabama. The history of Cambrian sedimentation and paleogeography in the region, based on a few areas of fairly homogeneous stratigraphy, is described, and the distribution of the Cambrian and age and correlation of its faunas are discussed for the northern, central and southern Appalachians and for various outcrop areas within these regions. — EH

01514 **Palmer, D. F.; Henyey, T. L.** San Fernando earthquake of 9 February 1971 — Pattern of faulting: Science, v. 172, no. 3984, p. 712-715, illus., 1971.

Mapping of the surface breaks that resulted from the San Fernando earthquake of 9 February 1971 reveals that the pattern of faulting was highly complex; it consisted of a number of segments that produced ground displacements and acceleration throughout the entire northern end of the San Fernando Valley. Instead of occurring on the frontal fault zone, as might have been expected, the faulting occurred on the

valley side of the frontal fault system, which separates the crystalline rocks of the San Gabriel Mountains from the Tertiary sediments of the San Fernando Valley. However, the new fault system does, in many cases, follow breaks in slope and subtle escarpments that suggest faulting along these zones in the recent geologic past. — Authors' abstract

Pascale, Charles A. *See* Foster, James B. 02067

Paul, Christopher R. C. *See* Kesling, Robert V. 01717

Pavlova, V. K. *See* Yatsimirskiy, K. B. 01868

01503 **Pearl, Richard Howard.** Pliocene drainage of east-central Colorado and northwestern Kansas: Mtn. Geologist, v. 8, no. 1, p. 25-30, illus., 1971.

At the close of deposition of the Ogallala Formation in late Cenozoic time, the ancestral Arikaree River was probably the major river crossing eastern Colorado and northwestern Kansas. It flowed east from the mountains near Pikes Peak, down the northeast-trending reach of Big Sandy Creek, then down the course of the present Arikaree. This conclusion is based on the presence of fresh, unweathered Pikes Peak Granite in the subsurface of the Ogallala Formation in northwestern Kansas, nature and lithology of the material comprising the formation, and analysis of drainage patterns of central and eastern Colorado. In late Pliocene or early Pleistocene, a northeast-flowing tributary of the lower South Platte River captured the headwaters of the ancestral Arikaree diverting it to the northeast. After another erosion period new tributaries of the South Platte and Arkansas Rivers developed in central Colorado. One tributary, comprising lower reaches of Big Sandy Creek, captured the upper part of the ancestral Arikaree River, diverting it southeastward. — *from* Author's abstract

08712 **Pearl, Richard Howard.** Method for estimating average coefficient of permeability using hydrogeologic field data, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 131-144, illus., tables, 1970.

The relations between average permeability and particle-size distribution in the Ogallala aquifer were derived by multiple regression. The only fractions significantly correlated with permeability were fine and very fine gravel. This result conflicts with most laboratory studies wherein permeability correlated highly with finer fractions. Most laboratory measurements are made on samples taken perpendicular to bedding, but average permeabilities of interest in the field relate to flow parallel to bedding. Therefore, correlations between permeability to horizontal flow and the larger size fractions may be of greatest significance for field use. — DBV

08723 **Pecora, William T.** The influence of modern life on the work of the Geological Survey: Annales Inst. Geol. Publici Hungarici, v. 54, no. 1, p. 99-103, 1970.

This article reviews the history of the U.S. Geological Survey and the changes that have taken place in its objectives and functions as man's needs and problems have changed. In the early days of the Survey its geologic maps and data were intended for use in the exploration and development of the unsettled territories of the United States by "intelligent agriculturalists, miners, engineers, and timbermen." Activities and research programs of the Survey are now concerned with exploration of the oceans and space and with problems of urban and industrial growth and concomitant increasing needs for minerals, fuels, construction materials and water. Besides expanding our knowledge of our environment and resources it is necessary to disseminate this knowledge to potential users in a form which they can easily understand. — EH

Pedraza, Carlos P. *See* Stanley, Daniel J. 01466

08730 **Pegler, A. V.** Instrumentation strain measurement stress calculation for excavation in rock (with French summ.), *in* Canadian Symposium on Mining Surveying and

Rock Deformation Measurements, 1st, Fredericton (New Brunswick), 1969, Proc.: Fredericton, Univ. of New Brunswick, p. 246-267, illus., table, 1970.

This paper describes the functions and applications of numerous types of instruments used for in-place stress measurements and determination of rock properties. Stress measuring equipment is treated in two main groups, extensometers and internal borehole meters. Only the Halliburton Microseismograph is discussed under rock properties instruments. There is a growing need for improved instruments, methods, and techniques for rock deformation measurement. — DBV

01778 **Pering, Katherine L.; Ponnamperuma, Cyril.** Aromatic hydrocarbons in the Murchison meteorite: Science, v. 173, no. 3993, p. 237-239, illus., table, 1971.

Polynuclear aromatic hydrocarbons in the Murchison meteorite have been identified by the combined techniques of gas chromatography and mass spectrometry. The distribution of the aromatic compounds suggests that they are the products of a high-temperature synthesis. — Authors' abstract

Perry, Byrne. *See* Mogel, Theodor R. 02002

Perry, E. C., Jr. *See* Tan, F. C. 01846

Perry, E. C., Jr. *See* Viswanathan, S. 01847

Pert, Donald M. *See* Zanier, Aldo M. 02031

01634 **Pestrong, Raymond.** Evaluating geologic hazards with multiband photography: Jour. Remote Sensing, v. 2, no. 2, p. 4-9, illus., 1971.

A simple effective multiband photographic system may be constructed from four synchronized 35 mm cameras, utilizing panchromatic, black and white infrared, Kodachrome, and Ektachrome infrared films plus the appropriate filters. Such a system minimizes spectral duplication and provides unique photographic signatures for a variety of terrain features of interest to the land planner. All of the required films are readily available in 20-exposure 35 mm formats, thereby facilitating utilization of the system with a minimum of specialized equipment. This type of analysis has been especially useful in the delineation of landforms along the margins of San Francisco Bay, as well as for the location of large landslides in the nearby coast ranges. As the landslides disrupt drainage and vegetation they show up most clearly on the Ektachrome infrared photographs. — Author's abstract

Peterman, Zell E. *See* Turek, Andrew. 02064

01873 **Peterson, Gary L.** Stratigraphy at the Poway area, southwestern California: San Diego Soc. Nat. History Trans., v. 16, no. 9, p. 225-236, illus., 1971.

Post-batholithic sedimentary rocks near Poway, Calif., previously mapped as Poway Conglomerate, consist of three distinct formations. The Lusardi Formation (Late Cretaceous), poorly sorted conglomerate containing locally derived clasts (Peninsular Ranges suite) ranging in size from granules to boulders 3 m in diameter, resembles type Lusardi near Rancho Santa Fe and pre-Poway fanglomerates near Lakeside and Alpine. Unconformably overlying the Lusardiare the Eocene Friars Formation (La Jolla Group) predominantly of sandstone and shale, and Stadium Conglomerate (Poway Group). Conglomerates from these units are exotic cobble-size metavolcanic, volcano-clastic and quartzite clasts (Poway suite). The Lusardi Formation fills a long narrow channel cut subsequent to mid-Cretaceous orogenesis. A subdued erosion surface, on the Lusardi and basement rocks, underwent severe weathering; Eocene formations were deposited on this surface. The Poway suite of clasts was derived from the east, transported across the erosion surface, and deposited in southwestern California. — *from* Author's abstract

Peterson, Sam H. *See* Dvoracek, Marvin J. 08769

02012 **Petrascheck, W. E.** Die Erzhöffigkeit Grönlands im Lichte der Kontinentalverschiebung [Prospective ore deposits in Greenland in light of continental drift]: Erzmetall, v. 24, no. 6, p. 257-260, illus., 1971.

A comparison is made between ore deposits of eastern Canada, southwestern Greenland and Western Norway and those of eastern Greenland in relation to continental drift. — *from* Author's abstract

01974 **Petruk, W.; Harris, D. C.; Murray, E. J.** An occurrence of valleriite from New Imperial mine, Yukon: Canadian Mineralogist, v. 10, pt. 5, p. 885-888, illus., tables, 1971.

The specimen, about 3/4 in. of quartered drill core, contained a valleriite with such a distinct X-ray diffraction powder pattern that it was used as a standard. In 1969, it was analyzed by electron microprobe and the data processed by computer; unit-cell dimensions were also obtained. Ore from this mine is composed of magnetite, bornite, chalcopyrite, chalcocite, copper, valleriite, covellite, and pyrite, disseminated in gangue. Magnetite is most abundant and contains inclusions and veinlets of copper-bearing minerals. Valleriite consists of alternating layers of copper-iron sulfide and magnesium-aluminum-iron hydroxide. Amounts of Cu, Mg, and S are constant and Al and Fe vary. — ESL

01494 **Phillips, C. H.; Cornwall, H. R.; Rubin, Meyer.** A Holocene ore body of cooper oxides and carbonates at Ray, Arizona: Econ. Geology, v. 66, no. 3, p. 495-498, illus., 1971.

Expansion of the Pearl Handle open pit at Ray, Arizona, uncovered a substantial Holocene deposit of copper oxides and carbonates in gravels of Mineral Creek. Concentration of oxide copper minerals in a small area at a sharp bend in the creek apparently resulted from a favorable topographic situation where ground waters that leached copper from the secondary sulfide blanket on Ray Hill were funneled down to the point of deposition in the channel gravels. A C-14 age of 7,000 yr B.P. of a fossil log in the deposit provides a maximum age for copper deposition. — *from* Authors' conclusions

01766 **Picard, M. Dane.** Petrographic criteria for recognition of lacustrine and fluvial sandstone, P. R. Spring oil-impregnated sandstone area, southeast Uinta Basin, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 36, 24 p., illus., tables, 1971.

The petrography of lacustrine and fluvial sandstones in the P. R. Spring area is examined as a guide in exploration for oil, most of which occurs in the lacustrine sandstone of the Garden Gulch and parachute Creek Members of Green River Formation. On the basis of modal analyses, the lacustrine sandstone contains more quartz and authigenic carbonate cement and less plagioclase, matrix, and coarse mica than the fluvial sandstone. Plots of quartz vs. feldspar, authigenic carbonate vs. matrix, quartz vs. plagioclase, quartz vs. matrix, and feldspar vs. matrix are useful in differentiating fluvial and lacustrine facies. The lacustrine sandstone is mineralogically and texturally more mature than the fluvial; differences are a function of environments of deposition. Red pigment in both facies is post-depositional; the fluvial sandstone has more pigment than the lacustrine. — VSN

Pierce, Jack W. *See* Stanley, Daniel J. 01489

Pilkey, Orrin H. *See* Bornhold, Brian D. 01443

01481 **Pinet, Paul R.** Structural configuration of the northwestern Caribbean plate boundary: Geol. Soc. America Bull., v. 82, no. 7, p. 2027-2032, illus., table, 1971.

Interpretation of 6,700 km of magnetic total intensity lines between Cayman Trough and coastal Honduras indicates that two distinct systems of transcurrent faults control the configuration of the northwestern Caribbean plate boundary. A master fault set trends ENE-WSW parallel to the long axis of the Cayman Trough and is characterized by extensive sinistral displacements; a second-order fault system trends NW-

SE and displays dextral offsets. Simple rotational shear deformation of rigid plates in a stress field generated by the eastward motion of the Caribbean plate relative to the North American plate can account for both fault sets. — *from* Author's abstract

01465 **Piper, J. W.; Normark, William R.** Re-examination of a Miocene deep-sea fan and fan-valley, southern California: Geol. Soc. America Bull., v. 82, no. 7, p. 1823-1830, illus., 1971.

Superb new three dimensional exposures of the Miocene lower Capistrano Formation near Dana Point, southern California, show all the principal depositional environments of the upper parts of a deep-sea fan. Thick, massive, coarse sands deposited on the suprafan pass up into sands deposited in a shallow channel flanked by silts. Large blocks of these silts periodically slid into the channel. Later, a deeper channel with steep walls was cut through the silts, and was filled with sands. The channels are comparable to deep-sea fan-valleys. The whole succession shows a progression from more distal to more proximal depositional environments. The effect of various scales of channeling on turbidity current deposition can be seen. — Authors' abstract

01541 **Pitman, W. C., 3d; Talwani, M.; Heirtzler, J. R.** Age of the North Atlantic Ocean from magnetic anomalies: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 195-200, illus., 1971.

Magnetic anomaly lineations have been identified in the North Atlantic. These lineations correlate with the magnetic time scale describing magnetic polarity reversals for the past 71 m.y. The results indicate that approximately 70 percent of the total drift between Europe and North America has occurred in the past 72 m.y., whereas only about 35 percent of the total drift between Africa and North America has happened in the same period. Extrapolation using the magnetic anomaly data and the results of JOIDES drilling suggests that drift between Africa and North America was initiated about 180 m.y. B.P. — Authors' abstract

Plafker, George. *See* Addicott, Warren O. 01407

Ponnamperuma, Cyril. *See* Pering, Katherine L. 01778

Porath, H. *See* Camfield, P. A. 01505

01506 **Porath, H.; Gough, D. I.** Mantle conductive structures in the western United States from magnetometer array studies: Royal Astron. Soc. Geophys. Jour., v. 22, no. 3, p. 261-275, illus., 1971.

Geomagnetic substorm fields were simultaneously recorded by a two-dimensional array of variometers covering western Texas, New Mexico, Arizona, and eastern California. Conductive structures in the upper mantle and crust have been determined from magnetograms and maps of Fourier-spectral components of two substorms. Structures under the Southern Rockies and Wasatch Fault Belt continue southward. The Basin and Range Province overlies a highly conducting region in the mantle. The anomalies are well represented by induction in a half-space of conductivity 0.2 $(\text{ohm-m})^{-1}$ with a ridge under the Southern Rockies and a step with superposed ridge under the Wasatch Fault Belt. Depths to the surfaces of the conductor are 190 km under the Basin and Range Province, 120 km under the Wasatch Fault Belt, 150 km under the Southern Rockies, and 350 km under the Colorado Plateau and Great Plains. This interpretation is not unique, however, — DBV

01721 **Porter, Christopher R.** A note on the quantitative evaluation of well logs in offshore southern California using the statistical method: Log Analyst, v. 12, no. 3, p. 3-6, illus., table, 1971.

The statistical method for determining water saturations from logs is applicable to the offshore Pliocene of southern California. The parameter P, defined in terms of porosity response and formation resistivity, displays a square root normal distribution for zones with water saturations of 100 percent. When hydrocarbon-bearing zones

are added to the statistical array the resulting distribution is different and unidentified. A ratio value R, in terms of the ranges of P-values present, is defined as R = 1 when 100 percent water-saturated zones are present and R > 1 when hydrocarbon-bearing zones are included. The final step is the calculation of resistivity index values ($I = Sw^{-n}$ where Sw is water saturation) from R values. In all cases the statistical method was successful in picking the hydrocarbon-bearing zones and in giving proper values for water saturation. — *from* Author's abstract

02006 **Porter, Stephen C.** Fluctuations of late Pleistocene alpine glaciers in western North America, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 307-329, illus., 1971.

Time-distance curves for late Pleistocene alpine glaciers show first-order fluctuations, having a time span of 10^4 years or longer, which appear broadly synchronous throughout the West, and correlate in a gross way with first-order fluctuations of the southern margin of the Laurentide ice sheet during the Wisconsin. Second-order fluctuations, having a time span of 10^3 years or less, show no uniformity of pattern from region to region. Furthermore, climatic control of such fluctuations can not be convincingly demonstrated, and many advances inferred from glacial-geologic evidence may represent either response of glaciers to isostatic effects or to random surges not climatically induced. Even where climate was the controlling factor, second-order terminal fluctuations are not likely to have been precisely synchronous regionally. — *from* Author's summary

01553 **Portmann, Jean-Pierre.** Géomorphologie de l'aire myriamétrique de Poste-de-la-Baleine (Nouveau-Québec) [Geomorphology of the 100 km-square area of Poste-de-la-Baleine (Nouveau-Québec) (with French and English abs.)]: Cahiers Geographie Québec, v. 15, no. 34, p. 53-76, illus., tables, 1971.

This 100 km-sq area on the eastern shore of Hudson Bay is essentially composed of Archean granite in the form of small platforms and ridges ranging in altitude from 30-85 m, and averaging about 58 m. Ridges, hills and lakes are oriented N. 60° E. and N. 110° E., and glacial grooves about N. 295° E. The imprint of glacial action is evident, but the action of the Quaternary Tyrrell Sea on the area is spectacular. Glacial deposits were reworked, therefore, remnants of moraines eroded by the sea, fields and rows of blocks, sand deposits occur. On the shore of Great Whale River, 10 km from its mouth, a polished and striated marine clay, with shells dated by the C-14 as 4000-4500 B.C., is covered by a bottom moraine. — *from* Author's abstract

Posen, A. *See* McGrosky, R. E. 01654

Potter, Paul E. *See* Webb, William M. 01821

Potter, Paul Edwin. *See* Horowitz, Alan Stanley. 01971

08766 **Pouba, Zdenek; Stemprok, Miroslav.** (editors). Problems of hydrothermal ore deposition; the origin, evolution and control of ore-forming fluids — Symposium, St. Andrews, Scotland, 1967: Stuttgart, Germany, E. Schweizerbart'sche Verlagsbuchhandlung (Internat. Union Geol. Sci., Ser. A, no. 2), 396 p., illus., tables, 1970.

This symposium was organized by the International Association on the Genesis of Ore Deposits, originally scheduled to take place in Belgrade. A large number of short contributions on hydrothermal deposits dealt with: source of metals, depth of formation, and vertical extent of ore deposition; regularities of different wallrock alterations in the course of mineralization processes; and replacement phenomena from the new physico-chemical and geochemical points of view. Papers on the first two topics are included in this volume. Two papers by R. W. Boyle, and one each by A. V. Heyl, and G. Machairas are cited separately. — GDC

01764 **Poupon, A.; Clavier, C.; Dumanoir, J.; Gaymard, R.; Misk, A.** Log analysis of sand-shale sequences — A systematic approach: Jour. Petroleum Technology, no. 7, p. 867-881, illus., 1970; Soc. Petroleum Engineers A.I.M.E. Trans. 1970, v. 249, p. 867-881, illus., 1971.

The method of continuous interpretation presented in this article has been widely tested on logs from various shaly-sand territories. Derived values of porosity, saturation, permeability and shale composition and the identification of gas zones and changes in lithology were confirmed by information from other sources. Where a complete suite of logs was available reasonable results were generally found. This method is not intended for areas where lithology becomes complex due to the presence of varying amounts of additional minerals as major constituents of the sand matrix and shales. The method does not solve the problems of very thin beds, where log readings are affected by the adjacent beds. It is believed that this method, when applied properly, will contribute significantly to the evaluation of hydrocarbon reserves in sand-shale sequences. — *from* Authors' summary

02033 **Poupon, Andre; Leveaux, J.** Evaluation of water saturation in shaly formations [abs.], *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. O1-O2, 1971.

08773 **Powell, Richard L.** Geology of the Falls of the Ohio River: Indiana Geol. Survey Circ. 10, 45 p., illus., 1970.

The Falls of the Ohio River, between Louisville, Ky., and Jeffersonville and Clarksvile, Ind., are the only exposure of bedrock on the Ohio River, an extensive Devonian coral bank and a type-locality for many fossil species. The stratigraphy and geologic history of the vicinity of the Falls are outlined, as well as the origin of the Ohio River Valley by glacial meltwaters. Outwash from various glaciations, which extended almost as far south as the study area, successively cut down the bedrock channel of the river and deposited thick sediments in Pleistocene times. These were partially eroded down to bedrock in Recent times. — EH

08758 **Preto, V. A.** Structure and petrology of the Grand Forks Group, British Columbia: Canada Geol. Survey Paper 69-22, 80 p., illus., tables, geol. maps, 1970.

This group, in the southernmost Shuswap Metamorphic Complex of southern British Columbia, is a raised fault block of about 22,000 feet of strata; 10,700 feet are metasediments, correlated in the lower part with latest Precambrian-early Paleozoic succession. Included amphibolitic rocks are predominantly of igneous origin. Metamorphism of highest amphibolite facies grade is described. Plutonic evolution began with basic intrusions in the sedimentary pile; metamorphic foliation in all units and granitic emplacements were later, during movement parallel to layering. In continued deformation, east-west folds indicate transport of south over north. Central uplift, folding about north-trending axes, retrograde metamorphism and potash metasomatism followed, with lastly, Eocene and Oligocene intrusion of stocks and dikes, then block faulting. — *from* Author's abstract

01952 **Price, W. A.; Tomlinson, K. W.** The effect of groynes on eroded beaches, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1053-1058, illus. [1971].

Laboratory tests are described, in which the effect of impermeable groynes on an eroded beach was studied. A beach was allowed to reach equilibrium for a particular wave climate and supply of littoral material. The foreshore was then manually eroded, and the beach allowed to return to equilibrium with and without groynes. It was found that the presence of groynes increased the rate of accretion but did not significantly build up the inshore beach beyond the stable levels. Bed levels seaward of the groynes were increased. — Authors' abstract

01842 **Prince, L. A.; Hanson, G. N.** Geochronology of the Giants Range Granite [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 57, 1971.

Prior, Jean Cutler. *See* Alexander, Charles S. 01715

01972 **Prokopovich, Nikola P.; Cole, Ralph C.; Nishi, Charles K.** Alteration of sediments by natural gases in western Merced County, California: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 826-832, illus., 1971.

Several areas with altered, highly acidic sediments (pH 1.5 to 4.5) are present in the upper part of fluvial deposits of the Plio-Pleistocene Tulare Formation. The alteration results from gases rising from deeper beds that were trapped locally under a clayey cap, where reactions between hydrogen sulfide, calcium-iron compounds in the sediments, and oxygen in ground water and soil atmosphere produced an acidic environment, with iron sulfides, native sulfur, gypsum, alunite, and related minerals. None of the minerals has commercial value, but the origin of alteration may provide guidelines for prospecting similar deposits. — HWR

02059 **Pucheit, Harald; Sabels, Bruno R.; Hoering, Thomas C.** Preparation of sulfur hexafluoride for isotope geochemical analysis: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 525-628, illus., table, 1971.

Sulfur hexafluoride can be prepared quantitatively and in a pure state from elemental sulfur and many sulfide minerals by the reaction with bromine trifluoride. The gas is very suitable for measurements of small differences in stable sulfur isotope ratios. The method has some advantages over those used at present. — Authors' abstract

02016 **Puente, Celso.** Records of precipitation, water levels, and ground-water recharge to the Edwards and associated limestones, San Antonio area, Texas, 1970: San Antonio, Texas, Edwards Underground Water District (in cooperation with U.S. Geol. Survey and Texas Water Devel. Board) Bull. 27, 11 p., tables, 1971.

Records of precipitation, water levels, and estimates of recharge to the Edwards and associated limestones in the San Antonio area during 1970 are summarized in this report. Rainfall for 1970 was below average throughout most of the recharge area. The water levels fluctuated just below the record high, owing to recharge from high flood runoff during intense storms. Ground-water storage in the Edwards Limestone remained above average during 1970. The estimated recharge was 661,600 acre-feet, which is about 30 percent above the average recharge for the period 1934-69. — Author's abstract

Pulpan, Hans. *See* Berg, Eduard. 02024

01771 **Purdy, Barbara A.; Brooks, H. K.** Thermal alteration of silica minerals — An archeological approach: Science, v. 173, no. 3994, p. 322-325, illus., 1971.

Extensive experiments indicate that the application of heat in flint materials may have conferred an advantage to primitive man in the manufacture of chipped-stone implements. When Florida cherts are slowly heated to between 350° and 400°C and maintained at this temperature for sustained periods, a desirable change occurs in the fracture properties. This alteration takes place when the melting point of the impurities within the intercrystalline spaces is reached; thus the microcrystals of quartz are fitted closer together when materials other than quartz serve as fluxes. — Authors' abstract

Purdy, William C. *See* Crump-Wiesner, Hans J. 01781

02054 **Pytkowicz, Richardo M.** Sand-seawater interactions in Bermuda beaches: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 509-515, illus., tables, 1971.

Surface seawater off several Bermuda beaches and in the upper few inches of intertidal sands in several-fold supersaturated with calcium carbonate. Precipitation of calcium carbonate and cementation of these sands is prevented by protective coatings. The depression of the pH by the oxidation of organic matter causes solution of calcium carbonate from deeper sands of the intertidal zone. — Author's abstract

Quinn, A. W. *See* Foland, K. A. 01783

01742 **Quinn, Alonzo W.** Bedrock geology of Rhode Island: U.S. Geol. Survey Bull. 1295, 68 p., illus., tables, geol. map, 1971.

This text, accompanying the State geology map, describes the various stratigraphic units and igneous rocks, tabulates their typical modes and radiometric ages: oldest,

the Blackstone Series and other metamorphic groups, precambrian(?)-Ordovician(?), folded and metamorphosed before Pennsylvanian time; and intrusives of one or more plutonic episodes, exposed by erosion before formation of the Mississippian(?) or older volcanic, hypabyssal, and plutonic East Greenwich Group. This latter group and Quincy Granite were exposed before Pennsylvanian deposition in the Narragansett basin, of several thousand feet of coarse nonmarine clastics which contain fossils and some meta-anthracite. Folded, faulted, progressively metamorphosed, these rocks were intruded by Narragansett Pier Granite, and that in turn by Westerly Granite. Two masses of vein quartz and several mafic dikes are also mapped, and on Block Island the Raritan Formation(?) of Late Cretaceous age. — GDC

Quinn, James G. *See* Farrington, John W. 01696

Quinn, James G. *See* Meyers, Phillip A. 02060

01550 **Qutub, Musa; Roy, Chalmer.** The status of states' certificates of earth science teachers: Jour. Geol. Education, v. 19, no. 3, p. 147-148, table, 1971.

A study shows that 19 states have definite requirements for certifying earth-science teachers. Requirements are tabulated according to semester hours in required earth sciences as well as in required related sciences. — EH

01905 **Radcliffe, Dennis; Berry, L. G.** Clinosafflorite — A monoclinic polymorph of safflorite: Canadian Mineralogist, v. 10, pt. 5, p. 877-881, tables, 1971.

Clinosafflorite is monoclinic. The sub-cell (corresponding to the safflorite orthorhombic cell) with a = 5.040A, b = 5.862A, c = 3.139A, $\beta = 90°13'$, contains 2 $[Co_{0.76}Fe_{0.14}Ni_{0.10}As_2]$ with D (calc) = 7.46. The apparent space group from indexed powder data is $P2_1/n$. The true cell, established for $CoAs_2$, with a and c doubled is B-centred monoclinic. Clinosafflorite, found in three specimens from Cobalt, Ontario, is intimately intergrown with skutterudite. Microprobe analyses of three specimens give a range of metal composition Co(0.70-0.76) Fe(0.14-0.26) Ni(0.01-0.10). Indexed powder data show that a decreases and b increases with increasing cobalt. The optical properties are very close to those of safflorite. Safflorite, from the Nipissing mine, Cobalt, with very similar composition, is also intergrown with skutterudite. Clinosafflorite and safflorite, close to the composition $Co_{0.75}Fe_{0.15}Ni_{0.10}As_2$, are polymorphic. — Authors' abstract

Radcliffe, S. V. *See* Green, H. W., 2d. 01486

01536 **Rahn, Perry H.** The weathering of tombstones and its relationship to the topography of New England: Jour. Geol. Education, v. 19, no. 3, p. 112-118, illus., tables, 1971.

Students divided tombstones in the West Willington, Conn., cemetary into six weathering classes. Analysis of the data, corrected to a common tombstone age of 100 years old, shows that: granite is virtually unweathered; schist is usually only slightly weathered; marble weathers rapidly and uniformly; and, red (Triassic) sandstone weathers fastest. The topography of New England is similar to these weathering rates: mountainous areas are chiefly made of granite; rolling hills are underlain by schist and other metamorphic rocks; small valleys in metamorphic terrane are underlain by marble; and, the Connecticut Lowland is underlain by Triassic sandstone and shale. These observations suggest that the topography is the result of differential weathering, possibly from one single erosion surface (the Schooley peneplain). — *from* Author's abstract

01726 **Raichlen, Frederic.** Tsunamis — Some laboratory and field observations, *in* Coastal engineering, V. 3 — Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 2103-2122, illus. [1971].

A unique laboratory facility to generate waves by impulsive movements of the bottom of a wave tank is described and examples of the wave forms which result are shown. An analytical method is presented for the case of rapid bottom movements

which describes, in a qualitative way, certain features of the experiments. Marigrams from various field stations for the tsunamis from the Chilean earthquake of 1960 and the Alaskan earthquake of 1964 have been analyzed using spectral analysis techniques to determine the harmonic components of these records. Comparisons are made between the spectra of the two tsunamis at each of several locations. — Author's abstract

01876 **Raleigh, C. B.; Kirby, S. H.; Carter, N. L.; Avé Lallemant, H. G.** Slip and the clinoenstatite transformation as competing rate processes in enstatite: Jour. Geophys. Research, v. 76, no. 17, p. 4011-4022, illus., 1971.

Clinoenstatite in deformed rocks is extremely rare. Experiments were conducted on the premise that transformation to clinoenstatite and slip in orthoenstatite are competing rate-controlled processes, with slip having the higher activation energy. At strain rates of 10^{-5} to 10^{-7} per sec, slip occurs in orthoenstatite without transformation to clinoenstatite at temperatures above 1300° to about 1000°C, respectively. The theoretical boundary between slip in orthoenstatite and transformation to clinoenstatite agrees well with the experimental. Extrapolation to geologically reasonable strain rates suggests that, above a temperature between 450° and 650° C, clinoenstatite will not form except where strain rates are abnormally high. This result appears to explain the near absence of clinoenstatite in naturally deformed pyroxenes. — *from* Authors' abstract

Ramanantoandro, R. *See* Christensen, Nikolas I. 01752

Ramaty, R. *See* Lingenfelter, R. E. 08763

01875 **Randich, P. G.** Ground-water basic data, Benson and Pierce Counties, North Dakota: North Dakota Geol. Survey Bull 59, pt. 2 (North Dakota Water Comm. County Ground-Water Study 18, Pt. 2), 360 p., illus., tables, 1971.

This hydrologic investigation of Benson and Pierce Counties, North Dakota, was made between 1967 and 1970. It includes data for about 1,780 wells and test holes, water-level measurements in 181 observation wells, logs of 667 test holes and selected wells, chemical analyses of 303 water samples and particle-size analyses of 177 samples of water-bearing materials. Results will be published in a hhydrologic atlas by the U.S. Geological Survey, and in three parts of the bulletin series of the North Dakota Geological Survey and the county ground-water studies series of the North Dakota State Water Commission. — EH

01704 **Randle, Keith; Goles, Gordon G.; Kittleman, Laurence R.** Geochemical and petrological characterization of ash samples from Cascade Range volcanoes: Quaternary Research, v. 1, no. 2, p. 261-282, illus., tables, 1971.

Neutron activation techniques were used on 29 samples of volcanic ash from the Pacific Northwest, in order to distinguish ashes from different sources. Preliminary results of petrographic studies of 42 ash or pumice samples are also reported. Geochemical characteristics of Mazama ash are defined, and problems caused by winnowing of crystalline material during transport and by weathering are discussed. La, Th, and Co contents and La/Yb ratios are good discriminants. Refractive indexes and proportions of crystalline material also aid in distinguishing among the ashes studied. Mazama ash is identified in archeological contexts at several sites in south central and north central Oregon. — DBV

01820 **Rapp, Richard H.** The direct combination of satellite and gravimetric data for mean anomaly determination: Ohio State Univ. Dept. Geod. Sci. Rept. 131 (Air Force Cambridge Research Lab. 71-0068), 56 p., illus., tables, 1971.

The computation of the external gravitational field of the Earth from satellite analysis and its subsequent combination with terrestrial gravity data usually has been done with spherical harmonic potential coefficients representing the Earth's gravitational potential. This paper examines the theory of the problem when the gravity field of the Earth is represented by discrete blocks on the surface of the Earth. Gravity anomalies

in these blocks now become the unknown parameters being sought. The determination of such anomalies is discussed as well as the procedure for directly combining terrestrial gravity information with this new type of satellite analysis. Results from a simulation study are given along with recommendations for the improvement of the tested method. Although no real data are used in the study procedures are outlined in the case real data are to be used. — Author's abstract

01733 **Rasool, S. I.; Schneider, S. H.** Atmospheric carbon dioxide and aerosols — Effects of large increases on global climate: Science, v. 173, no. 3992, p. 138-141, illus., table, 1971.

Effects on the global temperature of large increases in carbon dioxide and aerosol densities in the atmosphere of Earth have been computed. It is found that, although the addition of carbon dioxide in the atmosphere does increase the surface temperature, the rate of temperature increase diminishes with increasing carbon dioxide in the atmosphere. For aerosols, however, the net effect of increase in density is to reduce the surface temperature of Earth. Because of the exponential dependence of the backscattering, the rate of temperature decrease is augmented with increasing aerosol content. An increase by only a factor of 4 in global aerosol background concentration may be sufficient to reduce the surface temperature by as much as 3.5°K. If sustained over a period of several years, such a temperature decrease over the whole globe is believed to be sufficient to trigger an ice age. — Authors' abstract

02034 **Ratliff, J. R.; Throop, William H.; William, Fred G.; Hall, Jack D.** Applications of the SARABAND sand-shale technique in North America, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. P1-P23, illus., table, 1971.

This paper presents and discusses results of SARABAND shaly-sand computations performed in several wells in North America. The method is described briefly, also the program based on a formation model representing the shale and sand series. Two new routines are described: automatic detection of coal and lignite and an improved technique to measure hydrocarbon density. Four field examples of computations are presented to show some of the stages of processing, from the original logs to the final SARABAND output. The accuracy of the results is assessed against geologic or production data in each case. — DBV

01616 **Raymond, C. F.** Determination of the three-dimensional velocity field in a glacier [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 39-53, illus., tables, 1971.

A method for the determination of the three-dimensional velocity field in a glacier is described. Measurements in three or more bore holes arranged in an appropriate array are needed for its application. Surface motion measured by triangulation and tape measure, bore-hole profiles given by inclinometry, and the geometry of the bed are all considered simultaneously in order to determine the velocity field. The basic assumption is that velocity between the bore holes can be represented by suitable interpolation based on the measurements in the holes. Ice displacement parallel to bore holes is calculated indirectly from incompressibility and the constraint that velocity normal to the bed be zero. As an example, the method is applied to an array of 9 bore holes in Athabasca Glacier [Alberta]. — Author's abstract

01617 **Raymond, C. F.** Flow in a transverse section of Athabasca Glacier, Alberta, Canada [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 55-84, illus., tables, 1971.

Ice deformation, determined from tilting measured in nine bore holes, revealed in a nearly complete cross-section of this valley glacier that longitudinal flow is significantly different from that theoretically analyzed in cylindrical channels; relative strength of marginal and basal shear strain-rate is opposite to that of theory; averaged longitudinal flow velocity in glacier cross-section is larger by 12 percent than that seen at surface. Observed relation between marginal and basal sliding velocity may be due to lateral variation of water pressure at ice-rock contact. Longitudinal strain-

rate decrease with depth, nearly to 0 in center of glacier, cannot be explained completely by overall bending of ice mass with longitudinal curvature of the bed. Transverse flow diverges marginward, roughly symmetric; driven by the convex cross profile of the surface, lateral velocities averaged over depth are compatible with flux required for equilibrium of marginal surface parts under ablation. — GDC

08772 **Rayner, F. A.** Dynamic model of the Ogallala aquifer, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 111-117, illus., 1970.

Mathematical models are the most flexible method of simulating aquifers, and they can readily model storage depletion. However, one inherent inflexibility may limit their application to the Ogallala aquifer — the manner in which the model is partitioned for analysis. On the Ogallala, the top of the polygon is the water table and the bottom is some preselected elevation representing the base of the aquifer; both surfaces are assumed to be flat. Results of such a model have been surprisingly accurate, but the modeling has so far been confined to cases where the assumption of a flat aquifer base is not critical. Research is under way on a dynamic model which can automatically adjust its polygonal configuration through successive stages of depletion. If such a physically flexible model can be built, making it speak the language of management does not appear to be an insurmountable inflexibility. — DBV

01988 **Read, William F.** A new olivine-bronzite chondrite from De Kalb, Missouri: Meteoritics, v. 6, no. 2, p. 105-108, illus., 1971.

In the spring of 1969, an olivine-bronzite chondrite weighing approximately 575 g was found within the city limits of De Kalb, Mo. Though the discovery site is only 3 miles west of the known area of Faucett meteorites, "De Kalb" is shown in this paper to represent a distinct fall. — Author's abstract

Reading, Harold G. *See* Mitchell, Andrew H. 01676

08714 **Reddell, Donald L.** A mathematical model for determining areal distribution of natural recharge in the northern High Plains of Colorado, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 165-181, illus., tables, 1970.

A mathematical model is presented for calculating the areal distribution of net natural recharge to the Ogallala Formation in the High Plains of Colorado. With such information, an analysis can be made to determine the advantages or disadvantages of locating pumping centers in various areas. With adequate pumpage and water level data, the unsteady form of the model could be applied to other areas; in this case both the areal and time distribution of natural recharge could be determined. The finite difference method of calculating net recharge is limited quantitatively by the quality of input data. The best check of its applicability to full conditions is shown by the correlation between the discharge calculated from the finite difference method and that estimated from stream-flow measurements. — DBV

01474 **Reeves, C. C., Jr.** Relations of caliche to small natural depressions, southern High Plains, Texas and New Mexico: Geol. Soc. America Bull., v. 82, no. 7, p. 1983-1988, illus., table, 1971.

Most small natural depressions on the southern High Plains were produced by deflation or depositional irregularities of Pleistocene sand sheets, thus bear no genetic relation to the underlying Pliocene "caprock" caliche. Other small depressions have probably been produced by animals. The number of small depressions which reflect sinks in the underlying caliche is unknown. — Author's abstract

08708 **Reeves, C. C., Jr.** Drainage pattern analysis, southern High Plains, West Texas and eastern New Mexico, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 58-71, illus., tables, 1970.

The regional drainage pattern and the locations of large pluvial lake basins on the southern High Plains, West Texas, and eastern New Mexico, have been controlled by three lineament directions which correspond to the world's deep-seated regmatic fracture pattern. The most recent stresses which caused rejuvenation of the regmatic shear pattern in the area were of post-Pliocene but pre-late Pleistocene age. — Author's abstract

01418 **Reichen, Laura E.** Determination of sulfur in pyritic rocks by a single precipitation of barium sulfate after nitrate fusion, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B163-B164, tables, 1971.

Sulfur in pyritic rocks is determined gravimetrically by a single precipitation of barium sulfate. After sodium carbonate-potassium nitrate fusion, the addition of hydroxylamine hydrochloride to the acidified filtrate destroys nitrate and prevents its occlusion. The precipitate thus obtained is sufficiently pure to require no reprecipitation. — Author's abstract

Reid, Robert O. *See* Royer, Thomas C. 01701

02022 **Reineck, Hans-Erich.** Der Küstensand [Coastal sands]: Natur u. Mus., v. 101, no. 2, p. 45-60, illus., 1971.

Research in progress on coastal sands in Germany and the United States is discussed, as well as processes of deposition of sand in coastal areas. Sedimentary strata of the Rocky Mountains are used as examples in explaining marine transgressions and regressions over the North American continent in Cretaceous time. — EH

08761 **Rexroad, Carl B.** An outline of Silurian conodont zones in the Illinois Basin and the Cincinnati Arch area, *in* Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, p. 91-94, 1970.

On the basis of conodonts, mostly from a Cellon section in the Carnic Alps, Walliser (1962) subdivided Silurian rocks into seven preliminary conodont zones; in 1964 he refined these and recognized eleven zones. The lower part of the sequence is matched in general in the Illinois Basin and Cincinnati Arch area, where Nicoll and Rexroad (1969) named the *Icriodina irregularis*, *Neospathognathodus celloni*, and *Pterospathodus amorphognathoides-Spathognathodus ranuliformis* Assemblage Zones. Distribution of conodonts in these zones is given by their presence in various Silurian formations in the Illinois Basin and Cincinnati Arch area, and correlation with other areas of the Midwest and Ontario. Knowledge of overlying conodont sequences in the Midwest is still too fragmentary for zonation, but several key indices species in Europe are represented. — GDC

Reynolds, J. H. *See* Alexander, E. C., Jr. 01484

Reynolds, M. A. *See* Bogard, D. D. 01879

01533 **Reynolds, Peter H.; Dasch, E. Julius.** Lead isotopes in marine manganese nodules and the ore-lead growth curve: Jour. Geophys. Research, v. 76, no. 21, p. 5124-5129, illus., table, 1971.

Another study of lead-isotope compositions in marine manganese nodules has been made, using the double-spike method in conjunction with an absolute isotope standard. Observed Pb-206/Pb-204 and Pb-208/Pb-204 ratios are higher, or more radiogenic, than the corresponding zero model-age ore-lead abundances (end points of the primary ore-lead growth curves). Many of the leads, however, are probably present-day products of the ore-lead system. Total Pb-207/Pb-204 variation is much less than that found by Chow and Patterson in 1962. The rather small variations probably result in part from a simple mixing of lead derived from crustal and mantle sources. — Authors' abstract

01697 **Rho, J. H.** Grating anomalies in porphyrin spectra: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 743-747, illus., 1971.

Experimental evidence is presented to show that porphyrin spectra are modified by grating anomalies to such an extent that interpretation is difficult. The anomalies appear in a definite wavelength region which depends on the optical properties of individual grating monochromators, and are associated with polarization effects. The presence of light-scattering material in the samples of any fluorescent compounds may induce the formation of grating anomalies in their fluorescence spectra. The anomalies may easily be mistaken for porphyrin peaks, especially in samples which contain light-scattering material such as those from geological sources. — Author's abstract

01805 **Rice, H. M. A.** Some Devonian charophytes from western Canada: Canada Geol. Survey Paper 70-60, 23 p., illus., table, 1971.

Studies of 14 collections of Devonian charophytes in the paleontological collection of the Geological Survey of Canada have yielded three, possibly four species, which are described in this report. *Chovanella burgessi* Peck and Eyer occurs in six of the collections and five of these also contain *Eochara wickendeni00* Choquette. All are from strata reported to be of Givetran (late Middle Devonian) age. *Mollerina greenei* Ulrich, occurs in two collections both believed to be of Frasnian (early Upper Devonian) age. The remaining six collections contain charophytes that closely resemble *M greenei* but seem to be smaller and also to resemble, in many aspects, *Karpinskya bilineata* Peck. They are designated *?Moellerina greenei* and are from formations reported to range in age from Eifelian to Frasnian (early Middle Devonian to early Upper Devonian). — *from* Author's abstract

01570 **Rich, Edith.** (editor). Utah geology in print: Utah Geol. and Mineralog. Survey Quart. Rev., v. 5, no. 2, p. 3-11, 1971.

This is a list of papers appearing in 1970 which pertain to the geology and mineral industry of Utah. The papers are listed alphabetically by author, and according to a subject index classification. — EH

01600 **Richards, J. R.** Major lead orebodies — Mantle origin,: Econ. Geology, v. 66, no. 3, p. 425-434, illus., 1971.

Re-examination of ore lead isotope systematics shows that the simple single-stage development model fails in detail; other evidence suggests abandonment of the concept of a uniform upper mantle source and presumed constant proportion of U, Th, and Pb. A multistage model, either epidodic or continuous with more or less complete mixing at each stage, should be substituted; material in the crust is the major contributor to the isotopic pattern. Growth curve parameters such as 'age of Earth' or 'model age' of a deposit have only approximate relevance to the real state of affairs. Evidence confirms that the immediate *source* of ore lead sometimes may be sediments in the near vicinity with lead leached by aqueous solutions. Hot magma may supply energy for mobilization of such a solution but bear no isotopic relation. Isotope patterns reflect genetic relations between source rocks, solutions, deposits, and derivative magmas, but show only minor effects of transportation to mineralization site. — *from* Author's abstract

Richardson, A. *See* Watkins, N. D. 01743

02030 **Richardson, J. E.** A method of calculating the capture cross section of oil for use with pulsed neutron capture logs, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. I1-I7, illus., tables, 1971.

The value of the neutron capture cross section of oil, Σ_o, will depend upon the types of hydrocarbons present and can vary with changes in reservoir pressure. The use of generalized correlation charts may lead to Σ_o values which are significantly in error. For calculating Σ_o, use has been made of U.S. Bureau of Mines distillation data and of PVT data. An example calculation is given for the Helen Gohlke field, Texas, where the generalized chart value was 50 percent higher than the value calculated from this technique. It is concluded that the capture cross section of oil should be cal-

culated, where possible, for each separate oil reserve for use in quantitative interpretation work with pulsed neutron logging. — Author's abstract

Richmond, Gerald M. *See* Birkeland, Peter W. 01631

08741 **Richter-Bernburg, Gerhard.** Post-depositional structures in salt, *in* Geology and technology of Gulf Coast salt — Symposium, Baton Rouge, La., 1967, Proc.: Baton Rouge, La., Louisiana State Univ. School of Geoscience, p. 161-166, table, 1970.

[This is the last in a series of six talks presented when the author was Visiting Professor at LSU in April, 1967.] Many things can happen to salt to change its composition and structure after it has been deposited. Diagenetic changes include solution and redeposition as well as replacement. These cause minor changes in structure and gross changes in texture. Yet, despite these changes, some delicate original structures and textures can be preserved during intense diapirism. Subrosion (i.e., erosion occurring below the surface of the ground) forms salt tables and subrosion surfaces, some with overlying cap rock. Both fresh and saline waters are associated with salt deposits. Man accelerates resolution and subrosion, sometimes with disastrous effect. — Author's abstract

Ripley, L. G. *See* Nickel, E. H. 01895

02044 **Ritch, Harlan J.; Kozik, Harry G.** Petrophysical study of overpressured sandstone reservoirs, Vicksburg formation, McAllen ranch field, Hidalgo County, Texas, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. BB1-BB14, illus., 1971.

This paper presents methods and techniques which have been successfully used to drill, evaluate, complete, and produce the highly overpressured, low-permeability gas-bearing Vicksburg sand reservoirs in the McAllen Ranch field and area. To detect the overpressured zones, the Hottman-Johnson method of plotting shale interval velocities was used. The induction-electric and acoustic-caliper logs provided the basis for evaluation of reservoir quality sands and water saturation. The procedure developed to minimize formation failures is outlined. — DBV

01415 **Robbins, Stephen L.** Gravity and magnetic data in the vicinity of the Calaveras, Hayward, and Silver Creek faults near San Jose, California, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B128-B139, illus., table, 1971.

A gravity survey along the east side of San Jose, Calif., with stations spaced about 1-1.5 mi apart, shows a long, narrow 30-mgal gravity low, which may be caused in part by a graben extending into the lower crust and possibly into the upper mantle. Gravity gradients along the sides of this feature coincide with Calaveras and Silver Creek faults, with what appears to be the northwestward extension of the Silver Creek fault, and with what may be an old inactive fault in line with the still active Hayward fault. On the west side of San Jose a 25-mgal negative gravity anomaly is believed to indicate that the surface there is underlain by Tertiary and Quaternary rocks more than 4 km thick. Aeromagnetic data also show that Silver Creek fault extends northwestward beyond the area in which it is exposed. — *from* Author's abstract

Roberts, F. A. *See* Holser, W. T. 02037

01850 **Robertson, W. A.; Fahrig, W. F.** The great Logan's paleomagnetic loop — The polar wandering path from the Canadian Shield rocks during the Helikian era [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 58, 1971.

02068 **Robinson, B. W.; Morton, R. D.** Mckinstryite from the Echo Bay mine, N.W.T., Canada: Econ. Geology, v. 66, no. 2, p. 342-347, illus., tables, 1971.

Mckinstryite occurs as a late-stage, primary sulfide in this V-Co-Ni-Ag-Bi deposit, accompanying niccolite, rammelsbergite, chalcopyrite, bornite, covellite, and early

dolomite. It has an average composition (electron microprobe) of $Cu_{0.72}Ag_{1.28}S_{0.91}$, specific gravity of 6.64 ± 0.04, and is light-gray, weakly bireflectant, strongly anisotropic, and biaxial positive. — *from* Authors' abstract

01763 **Robinson, Edwin S.** Ground water reservoir response to Earth tides: Virginia Polytech. Inst. and State Univ. Water Resources Research Center Bull. 40, p. 55-65, tables [1971].

A study was undertaken in Virginia to examine tidal water-level fluctuations in wells and to relate quantitatively the observed tides and ground-water reservoir storage parameters. Data from 30 wells were examined and tides were identified in 12 of them. Quantitatively reasonable relationships between tides and aquifer porosity and bulk modulus were established for seven wells. Data were insufficient to establish good quantitative relationships for three wells and data from two wells showing well-developed tides were received too late for analysis. In this report the theoretical response of well-aquifer systems is first considered. Examinatoion of the observed data then confirms this theory. Finally, an evaluation of the applicability of tidal studies in aquifer investigations is presented. — *from* Author's abstract

01668 **Robinson, J. E.; Merriam, D. F.** Z-trend maps for quick recognition of geologic patterns: Internat. Assoc. Math. Geology Jour., v. 3, no. 2, p. 171-181, illus., 1971.

Z-trend maps are a simplified lineprinter version of spatially filtered maps designed to give a quick visual appraisal of trends. The printout shows a "yes-no" configuration by a printed character or a blank so that the map has a conspicuous pattern which reflects the presence, position and trend of the desired features. If a reasonable symbol density ratio is used, the results can be visually pleasing, thus enhancing trend recognition. Z-trending can be adapted to any map with stationary properties but is most easily applied to data that have been filtered with a bandpass operator. — Authors' abstract

08724 **Robinson, S. C.** The role of the Geological Survey of Canada in storage and retrieval of geological data: Annales Inst. Geol. Publici Hungarici, v. 54, no. 1, p. 131-139, 1970.

This article outlines the activities of the Geological Survey of Canada in geological mapping, economic geology, geochronology, and other fields of geology, and the development of a computerized storage and retrieval system for the vast quantities of data amassed in each field. It is based on a system of separate owner-controlled files, each using a national index for coordination. Over 135 computer-based files of earth sciences data exist at present in Canada, some in the Geological Survey and some in provincial governments. A Canadian Geoscience Data Institute is being organized to supplement the national system and to guide the development of computer applications in the earth sciences. — EH

Robinson, W. E. *See* Anders, D. E. 01693

01433 **Robison, Tully M.** Earthquake-accelerated decline of water level in an observation well in St. Thomas, Virgin Islands, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B252-B253, illus., 1971.

A minor local earthquake caused a precipitate decline in the water level of an observation well in St. Thomas, Virgin Islands. The decline continued for over 3 months. The cause of the decline is assumed to be fracturing of the aquifer. — Author's abstract

01437 **Rodgers, John.** The Taconic orogeny: Geol. Soc. America Bull., v. 82, no. 5, p. 1141-1177, illus., 1971.

The Taconic orogeny was a complex series of orogenic episodes spread over the larger part of the Ordovician period. It included disconformity in an external belt where carbonate was accumulating, severe early deformation in an internal volcanic belt, gravity slides from internal uplifts into the external belt, and widespread defor-

mation. These events did *not* occur at the same time in the various sectors; each took a considerable time, and they overlapped to some extent. Detailed analysis of the "fine structure" of the Taconic orogeny combats the dogma that orogenies are sharp, discrete events punctuating the geologic record (separating periods and abruptly terminating geosynclinal sedimentation) and suggests instead that they reflect "random-walk" processes within the Earth, in all likelihood the same as those responsible for sea-floor spreading and the present tectonic state of the Earth. — *from* Author's abstract

01660 **Roegiers, J. C.; Hudson, J. A.; Fairhurst, C.** A note on controlled crack growth in hydraulic fracturing of rock: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 98-103, illus., 1971.

A method of servo-control with displacement feedback is described which provides a useful way of studying the stages of crack initiation and propagation in hydraulic fracturing. — DBV

02061 **Rogers, M. A.; Bailey, N. J. L.; Evans, C. R.** A plea for inclusion of basic sample information when reporting geochemical analyses of crude oils: Geochim. et Cosmochim. Acta, v. 35, no. 6, p. 632-636, illus., tables, 1971.

Sufficient basic information must be provided for an oil before analytical results can be used either to interpret its original source or to understand its generation. A format covering seven items of basic information is proposed when reporting oil analyses. — Authors' abstract

Rohrbacher, T. J. *See* Vogel, T. A. 01848

01920 **Rojković, Igor.** Cobalt-nickel arsenides and sulfarsenides of some U-Co-Ni-Bi-Ag veins at Great Bear Lake, Canada: Slovensk. Akad. Vied. Geol. Zbornik, v. 22, no. 1, p. 79-96, illus., tables, 1971.

Cobalt-nickel arsenides and sulfarsenides are widespread minerals of U-Co-Ni-Bi-Ag veins at the Great Bear Lake area. Ore microscopy, X-ray powder diffraction and electron microprobe studies were made of the following minerals of this group: niccolite, maucherite, rammelsbergite, safflorite, skutterudite, gersdorffite and cobaltite. They occur in close association with native silver, and follow pitchblende and precede sulfides in sequence of ore mineralization. — *from* Author's abstract

01864 **Rold, John W.** Pollution problems in the 'oil patch': Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 807-809, illus., 1971.

Oil field practices can and do pollute ground water. Such pollution may not appear immediately, but its effects may persist for many years. Sources may be from evaporation pits, insufficient surface casing, injection system, abandoned wells, oil spills, or seismic shotholes. Constant planning monitoring, and policing of an operation may not prevent all pollution but will help and will save considerable money. — VSN

01546 **Romey, William D.** The Earth Science Educational Program: Jour. Geol. Education, v. 19, no. 3, p. 119-123, 1971.

The status of the three major projects which comprise the Earth Science Educational Program (ESEP) are reviewed. The Earth Science curriculum Project (ESCP) which is being terminated, has produced a textbook, teachers' guide, films and other publications. The Earth Science Teacher Preparation Project (ESTPP) has set up model programs and workshops both for pre-service and in-service teachers. Environmental Studies for Urban Youth has produced materials based on a divergent learning model. — EH

01671 **Ronov, A. B.; Migdisov, A. A.** Geochemical history of the crystalline basement and the sedimentary cover of the Russian and North American platforms: Sedimentology, v. 16, no. 3-4, p. 137-185, illus., tables, 1971.

In comparing over 8,000 chemical analyses of main rock types in these crystalline shield and sedimentary platform structures as a whole and separately in very large stratigraphic complexes, important stages in compositional development were traced for the last 3.5 b.y.; general tendencies in their geochemical history are outlined. The "granitic" shell's average composition is almost uniform; the sedimentary cover and its transformation is strikingly similar for different continents. Discrepancy between shield rocks and derivative platform sediments indicates more abundant basic rocks in earliest crustal development. Evolutionary tendencies relate with: granitization of primary material; cyclic weathering and sedimentation of denudation products; and growth of biosphere and life density which determined change in composition of atmosphere and ocean and oxidation-reduction conditions on the Earth's surface and in its sedimentary series. — GDC

Roos, A. *See* Bakker, W. T. 01951

Rowe, J. J. *See* Greenland, L. Paul. 01420

01694 **Rowe, M. W.; Clark, R. S.** Estimation of error in the determination of Al^{26} in stone meteorites by indirect γ-ray spectrometry: Geochim. et Cosmochim. Acta, v. 35, no. 7, p. 727-730, tables, 1971.

The error involved in the determination of the Al-26 concentration by the method of Rowe and his co-workers was measured and the values they reported should be increased by a factor of 1.36 ± 0.05. The potassium contents of the meteorites measured by Rowe, et al., are not affected by this error and can be used with confidence. — Authors' abstract

Roy, Chalmer. *See* Qutub, Musa. 01550

Roy, Robert F. *See* Hinze, William J. 01825

01701 **Royer, Thomas C.; Reid, Robert O.** The detection of secondary tsunamis: Tellus, v. 23, no. 2, p. 136-142, illus., table, 1971.

The long-wave data recorded at Wake Island during the time period of 9-12 March 1957 are analyzed through application of a variable period band pass filter successively centered at periods of 6, 20, 55, and 100 min. The primary tsunami of 9 March 1957 generated in the Aleutian Islands is observed in all the filtered records as well as in the original record. Several hours after the primary tsunami, additional bursts of wave energy begin to appear in the filtered records. The later arrivals are well correlated with the expected arrival times of long surface gravity waves generated by aftershocks of the initial tsunamigenic earthquake. These secondary tsunamis are most distinctive in the 55 and 100 min period filtered records, and are theorized to have been generated by nonpermanent or transient ground displacements. — *from* Authors' abstract

Rubin, Meyer. *See* Phillips, C. H. 01494

Rummel, F. *See* Hudson, J. A. 01656

02083 **Runge, R. J.; Hill, D. G.** The role of anisotropy in ULSEL, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. J1-J23, illus., table, 1971.

The total electrical anisotropy of a large volume of earth in which an ultralong spaced electric logging survey is conducted is an important parameter in making a successful interpretation. The significance of errors in this parameter is discussed. Lack of logging methods which satisfactorily measure the vertical components of resistivity thwarts efforts to obtain total electrical anisotropy. Statistical approaches to this problem are developed wherein the input parameters are averages obtained from an induction log and an SP log as well as core measurements. The problem of making core measurements to obtain rms shale anisotropy is considered and core measurement results are discussed in connection with this problem in the Gulf Coast. — DBV

Runnels, Donald D. *See* Boberg, Walter W. 01497

01843 **Ruotsala, A. P.** Characteristics of some alteration minerals, Portage Lake Lava Series, Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 59-60, 1971.

02074 **Ruppel, Byron D.** Geophysics of the Great Valley-Franciscan junction between Paskenta and Stony Ford, California: Geol. Soc. America Bull., v. 82, no. 6, p. 1717-1722, illus., table, 1971.

Four east-west gravity and aeromagnetic profiles across the west border of the Sacramento Valley are interpreted in terms of models fitted to surface geology and physical properties of rock samples collected along the profiles. The results indicate westward dip of the anomaly-producing rock masses. — AG

01817 **Russell, Donald R.** An essay on the caves of the Cherokee Nation — A conservation plea: Broken Arrow, Okla. (privately printed), 50 p., illus., 1971.

Caves of eastern Oklahoma in the western flanks of the Ozark uplift are described. The cave systems are in the dense Pitkin limestone just beneath the sand and limestone protective cap of the Hale Formation which is close to the surface in this area. The Pitkin Formation, in the upper Chesterian Series of the Mississippian system, is separated by a thin bed of shale from the Hale Formation in the lower Morrow Series of the Pennsylvanian system. The Pitkin caves, the Spavinaw Valley caves to the north of them in limestone of the Mississippian Mayes Formation, and the caves of the St. Joe limestone are described. Descriptions of fossil remnants, abundant in these caves, and of modern cave fauna and flora are included. — EH

01510 **Rutishauser, Heinz.** Observations on a surging glacier in East Greenland: Jour. Glaciology, v. 10, no. 59, p. 227-236, illus., 1971.

Recent observations on Björnbo Gletscher, East Greenland, have revealed that it has characteristics of a surging glacier. One outstanding feature is the occurrence of drop-like ice masses in the lower part of the glacier which do not appear to belong to the main glacier. A detailed petrographic comparison between morainic debris surrounding these drop-like ice masses and rocks occurring in the upper part of the glacier indicates that the drop-like masses have been inserted into the main glacier. This drop-like form is probably due to ice transport from the side valleys, occurring over a short period of time during the surge of the main glacier. Because of highly variable rock types occurring in the respective accumulation zones, petrographic examinations of other moraines in the ablation zone were used to trace them to their firm fields. The main glacier and tributary glaciers are now static. Björnbo Gletscher is therefore characterized by both static and moving phases, and its dynamics are the same as those of surging glaciers. The quiescent phase is estimated at about 100 years; the next surge will presumably occur around 1990. — *from* Author's abstract

01526 **Rutter, Nathaniel W.** Quaternary geology road logs, Banff area, Alberta: Canada Geol. Survey Paper 70-67, 25 p., illus., 1971.

This paper contains six road logs dealing with aspects of the Quaternary geology in the area of Banff, Alberta. — Author's abstract

Sabels, Bruno R. *See* Puchelt, Harald. 02059

Sackin, M. J. *See* Srivastava, G. S. 01670

Sacks, I. Selwyn. *See* Linde, Alan T. 02065

01601 **Salomons, W.** Isotope fractionation between galena and pyrite and between pyrite and elemental sulfur: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 236-238, tables, 1971.

Sulfur isotope fractionation between pyrite and galena and between pyrite and elemental sulfur was investigated. Isotope equilibrium was not achieved in 120 days at 400°C and 500°C, nor in 40 days at 600°C. Slow diffusion of sulfur isotopes in pyrite and the isotopic inhomogeneity of the pyrite crystals are probably responsible. By the

techniques used so far, isotope equilibrium in systems containing pyrite cannot be reached in a reasonable amount of time at the temperature investigated. — Author's abstract

Sahjha, S. K. *See* Venkatachala, B. S. 01719

Sanders, John E. *See* Friedman, Gerald M. 01798

Sanford, Robert B. *See* Swift, Donald J. P. 01672

01496 **Sangster, D. F.** Metamorphism as an ore-forming process [discussion of "'-Metamorphic' and 'metamorphosed' sulfide deposits," by A. Mookerjee, 1970]: Econ. Geology, v. 66, no. 3, p. 499-500, 1971.

The paper under discussion was published in ibid., v. 65, no. 7, p. 886-889, 1970; Abs. North American Geology, April 1971.

Savichenko, Ya. S. *See* Yatsimirskiy, K. B. 01868

Savin, S. M. *See* Lyons, J. B. 01619

Savin, Samuel M. *See* Hecht, Alan D. 01687

01768 **Saxena, Surendra K.** $Mg^{2} + Fe^{2}$ order-disorder in orthopyroxene and the Mg^{2+}-Fe^{2+} distribution between coexisting minerals: Lithos, v. 4, no. 3, p. 345-354, illus., tables, 1971.

An approximate temperature of crystallization of rocks and important information on the thermodynamic nature of a crystalline solution, coexisting with orthopyroxene, can be obtained by using the experimental Mg^{2+}-Fe^{2+} intra-crystalline distribution data in orthopyroxenes at various temperatures and the inter-crystalline Mg^{2+}-Fe^{2+} distribution data in the minerals of the natural assemblage. Ca-pyroxene Ca (Mg, Fe) Si_2O_6 with the M2 site nearly filled by Ca, is a 'simple mixture' of Mg^{2+} and Fe^{2+} components with an energy constant W approximately 1023 cal per mole at 680°C. Estimated temperature of ion-exchange equilibrium between coexisting cummingtonite and orthopyroxene in Biwabik Iron Formation, Minnesota, is 620°C. Cummingtonite also approximates to a 'simple mixture' with W as 834 cal per mole at 620°C. — Author's abstract

01947 **Saylor, James H.; Hands, Edward B.** Properties of longshore bars in the Great Lakes, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 839-853, illus. [1971].

Nearshore bathymetry and sediment properties were studied from 1967 to 1969 along a 45-km reach of the eastern coast of Lake Michigan. Results show that offshore bars migrate significantly due to lake-level changes; a one-half-meter rise in the surface of Lake Michigan between 1967 and 1969 was accompanied by a shoreward movement of bar crests and troughs averaging 30 m. Elevations of crests and troughs are built upward toward new equilibrium levels during rising water levels, but elevating of the crests lags the increase in stage. Extensive shore erosion occurs because of reduced effectiveness of longshore bars in dissipating incident wave energy. Average crest depth increases linearly in the offshore direction. Average distances between crests increase exponentially. These relations are preserved during bar growth and shifting accompanying long-term lake-level changes. Fathograms show atypical trough configurations of flat bottoms with discontinuities in slope on ascent to adjacent crests. This unusual shape indicates an immobile stratum exposed along the bottom of the trough. — *from* Authors' abstract

Sazonov, M. L. *See* Veber, V. V. 01723

01923 **Schaeffer, Bobb.** The braincase of the holostean fish *Macrepistius*, with comments on neurocranial ossification in the Actinopterygii: Am. Mus. Novitates, no. 2459, 34 p., illus., table, 1971.

An uncrushed and nearly complete braincase of the amioid *Macrepistius arenatus* Schaeffer, 1960, from the Lower Cretaceous (Albian) Glen Rose Formation near Boyd, Wise County, Texas, is described; assignment of the type specimen, a dermal skull (Schaeffer, 1960) to Caturidae is confirmed in part by the braincase, which, however, differs from those of other caturids (and apparently other actinopterygians) in having paired, partly fused supraoccipitals, clearly separated from the epiotics. On the basis of shared derived characters, *Macrepistius* could possibly have a "sister" relationship with either *Osteorhachis* or *Heterolepidotus*; the unique specializations of *Macrepistius* are interpreted as evolving from a caturid with pointed teeth, relatively narrow palate and infraorbitals, and no supraoccipitals. The neurocranial ossification pattern is analyzed in comparison with those of other actinopterygians, and a basic uniformity is demonstrated. — VMJ

01861 **Schanz, John J., Jr.** Economic aspects of exploration and development of mineral resources — Viewpoint of the educator: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 6, p. 792-795, 1971.

Economics set company guidelines for exploration, but geologists are inadequately trained in that field. "Economic geology" has become more concerned with the geology of the economic deposit that what makes it economic. Sequential undergraduate and graduate courses in economics, tuned to the needs of exploration geology, could stress economic concepts that relate to nonrenewable resources and deposit evaluation and commodity trends and analysis as related to planning exploration programs. Technical programs of geologic societies should begin to include papers on modern applications of economics in exploration and evaluation and papers on broader economic concepts that relate to national mineral policy. — BHK

Scheidegger, A. E. *See* Ghosh, A. K. 01787

02042 **Schmidt, A. W.; Land, A. G.; Yunker, J. D.; Kilgore, E. C.** Applications of the CORIBAND technique to complex lithologies, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Z1-Z27, illus., 1971.

The CORIBAND computer program has been used to solve interpretation problems in reservoirs of complex lithology. This paper reviews the general CORIBAND technique and discusses field examples of practical interest in wells in the United States and Canada. Log-data crossplots used to determine CORIBAND options and select parameters are shown. These include the Z-PLOT which allows simultaneous interpretation of any combination of three logging parameters. The choices of "interpretation models" and shale parameters are discussed. In each example, the CORIBAND results are compared with the available geologic data and production history. — Authors' abstract

Schmidt, V. A. *See* Dunn, J. R. 01483

Schmitt, R. A. *See* Borchardt, G. A. 01629

Schmitt, Thomas J. *See* Hecht, Alan D. 02072

Schneider, Arland D. *See* Jones, Ordie. 08711

Schneider, Arland D. *See* Aronovici, V. S. 08715

08717 **Schneider, Arland D.; Wiese, Allen F.; Jones, Ordie R.** Movement and recovery of herbicides in the Ogallala aquifer, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 219-226, illus., table, 1970.

Data from three ground water recharge pollution studies at the Southwestern Great Plains Research Center are presented. — DBV

Schneider, S. H. *See* Rasool, S. I. 01733

01880 **Schnetzler, C. C.; Bottino, M. L.** Some alkali, alkaline earth, and rare earth element concentrations and the Rb-Sr age of the Lost City meteorite and separated phases: Jour. Geophys. Research, v. 76, no. 17, p. 4061-4066, illus., table, 1971.

The Lost City chondritic meteorite and mineral concentrates from it were analyzed by mass-spectrometric isotope dilution. Concentrations of the alkali elements Li, K, and Rb; alkaline earth elements Ba and Sr; and rare earth elements Ce, Nd, Sm, Eu, Gd, Dy, Er, Yb, and Lu in the bulk sample are quite typical of ordinary chondrites, except for a small (approximately 10 percent) negative Eu anomaly. At least 30 to 60 percent of the rare earth elements are not located in the major phases of Lost City and presumably are in a minor phosphate phase or phases. A Rb-Sr model age of 4.68 b.y. is obtained for the meteorite; data on mineral concentrates, however, suggest that radiogenic Sr has migrated within the system. — Authors' abstract

Schnoes, H. K. *See* Haug, Pat. 01578

01684 **Schurmann, K.; Hafner, S. S.** Temperature-dependent distribution of magnesium and iron in cummingtonites: Nature Phys. Sci., v. 231, no. 24, p. 153-156, illus., table, 1971.

Experiments have been carried out which suggest that the thermodynamic characteristics of the intracrystalline Mg^{2+}, Fe^{2+} exchange in cummingtonite from the Quebec Iron Formation are very similar to those of orthopyroxenes. Calculations of the standard Gibbs free energy difference for the exchange indicate that the Mg, Fe^{2+} distribution in cummingtonites depends critically on the cooling rate of the rock in the range of approximately 700°-480°C. — DBV

Schwartz, G. *See* McGrosky, R. E. 01654

01525 **Schwarz, E. J.** Magnetochemical aspects of the heating of red and green beds: Canada Geol. Survey Paper 70-63, p. 31-34, illus., 1971.

Thermomagnetic analyses of Paleozoic red sandstones, containing green sandstone inclusions, collected in New Brunswick, Canada, show that a significant amount of Fe_3O_4 is generated in the red matrix if heated in air of low pressure or in nitrogen atmosphere although no magnetite is generated in the inclusions. Microscopic investigation of thin sections of the red and green sediments revealed only minor mineralogical differences with the exception of the pigment. X-ray diffractograms of the sediments essentially match. It is concluded that the pigment minerals in the red sediments were involved in the production of magnetite. Thermomagnetic records showed that part of the hematite which was present only in the red matrix may have been reduced to magnetite. Dehydration of iron (oxy-) hydroxides probably did not play a significant role in the production of magnetite or such compounds would also be present in the green inclusions. — *from* Author's abstract

01434 **Scott, C. H.; Culbertson, J. K.** Resistance to flow in flat-bed sand channels, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B254-B258, illus., 1971.

The flat bed that is characteristic of upper regime flow commonly occurs at high discharge in sand channels. Data from many channels with sand beds show that for a flat bed or for a dune bed velocity varies with hydraulic radius to one-half power, indicating a constant value of Chezy C or C.. Values of C. for upper regime flow for 24 channels used in a regression analysis to determine the effect of median particle diameter of bed material and of slope on values of C., show that C. could be expressed as a function of median particle diameter alone. — *from* Authors' abstract

01913 **Scott, J. S.** Surficial geology, Rosetown, west of third meridian, Sasketchewan: Canada Geol. Survey Map 1249A, scale 1:253,440, 1970; also available in Canada Geol. Survey Bull. 190, 1971.

01914 **Scott, J. S.** Surficial geology of Rosetown map-area, Saskatchewan (72 0) (with French, German, and Russian abs.): Canada Geol. Survey Bull. 190, 40 p., illus., table, geol map, 1971.

The region is underlain by Upper Cretaceous strata which was subjected to extensive denudation during late Tertiary, and Tertiary sediments are absent. Surficial deposits consist of till in various forms. Boreholes show multiple layers of till separated by stratified sediments, which cannot be correlated within the area. Radiocarbon dates indicate that Pleistocene deposits are of late Wisconsin age. Recession was accomplished primarily by stagnation and downwasting by melting. Minor re-advances of the glacier occurred. Post-glacial uplift has been in excess of 100 feet as indicated by alluvial infilling in the valley of the South Saskatchewan River. Besides the geologic map, a bedrock-topography map, sections of Pleistocene stratigraphy, and a map showing glacial history accompany the report. — ESL

01707 **Scott, Robert B.** Chemical variations in glass shards and interstitial dust of ignimbrite cooling units: Am. Jour. Sci., v. 270, no. 2, p. 166-173, illus., 1971.

Microprobe studies of glass shards and interstitial dust reveal chemical variations similar to those in suites of hand specimens collected from vertical sequences through ignimbrite cooling units. Inverse Na-K relationships are pronounced in fine-grained matrix dust and less pronounced in coarser shards; this distribution of alkalis is probably the result of alkali-ion exchange between aqueous fluids and glass during cooling, but in part may result from time-dependent ion exchange with ground water after secondary hydration. Calcium, magnesium, and iron have been added only to interstitial matrix material; this effect is probably the result of exchange with ground water. A slight depletion of both alkalis in matrix material relative to shards may be related to leaching after cooling. The matrix dust is more susceptible than shards to alteration because of the higher surface area of the matrix per unit volume. — Author's abstract

01975 **Scott, S. D.** Mössbauer spectra of synthetic iron-bearing sphalerite: Canadian Mineralogist, v. 10, pt. 5, p. 882-885, illus., table, 1971.

A study by Manning (1967) postulates the occurrence of ferric iron in interstitial (octahedral) sites in sphalerite. If this is true, then the state of the iron may be an indicator of sulfur fugacity and/or temperature during deposition. As a preliminary study, the valence and coordination of iron in four synthetic sphalerites, covering a range of growth conditions and compositions, were examined by Mössbauer spectroscopy. Spectra obtained were all nearly identical, with two lines of equal intensity resulting from quadrupole splitting. Lack of additional spectral lines demonstrates that there is no iron in octahedral sites. At least 95 percent of the iron in each sphalerite is in +2 valence state and randomly distributed over tetrahedral sites. The study showed that the state of the iron does not change with conditions of growth so is of no use as a geothermometer. — ESL

02032 **Segesman, Francis; Liu, Olive.** The excavation effect, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. N1-N24, illus., tables, 1971.

Because of the excavation effect, gas or light hydrocarbons near a well will lower the neutron log reading more than expected by taking into account only the lower hydrogen density. A reversed effect is possible, but less likely, when the hydrocarbon has a hydrogen index > 1. The excavation effect is computed for clean and shaly cases, as the difference between neutron readings expected from hydrogen index and from neutron slowing-down-length computations. The results can be described by average curves for various porosity values versus hydrogen index of the pore-filled mixture. A chart and an equation are given for estimating the excavation effect in clean formations and correcting the neutron reading; these may be used to approximate the excavation effect in shaly formations when entered in the manner described. The excavation effect correction has been incorporated in interpretation charts and computer interpretation programs. — DBV

Shacklette, H. T. *See* Connor, J. J. 01454

Shao, C.-Y. *See* McGrosky, R. E. 01654

01417 **Shapiro, Leonard.** Rapid scanning technique for low levels of CO_2 in silicate rocks, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B161|B162, illus., table, 1971.

Carbon dioxide evolved from a 25-mg sample of pulverized rock is caught in a small bulge of a modified test tube, and its volume estimated by comparison against similarly processed standards. The method is restricted to CO_2 concentrations ranging from 0.0 to 0.1 percent and is especially applicable to most igneous rocks and silicate minerals. The standard deviation is 0.02 percent CO_2. Samples can be analyzed rapidly at the rate of 2 minutes each. The procedure is useful for screening samples containing more than 0.1 percent CO_2, where greater accuracy in analysis is warranted. — Author's abstract

01792 **Shaver, Robert H.** (and others). Silurian and Middle Devonian stratigraphy of the Michigan Basin — A view from the southwest flank, *in*Michigan Basin Geol. Soc. Ann. Field Excursion, 1971 [Guidebook] — Geology of the Lake Erie Islands and adjacent shores: [East Lansing?, Mich.] Michigan Basin Geol. Soc., p. 37-59, illus., 1971.

Correlatable units of these Systems in northern Indiana constitute a thinner, structurally updip but depositionally similar section several hundred feet thick, equivalent to parts measured in thousands of feet in the deep Michigan Basin proper. The Indiana representation, covered as elsewhere by younger strata and glacial deposits, lacks many of the named more northern units; basin center-to-margin facies relations are contentious. Reviewed are lower Niagaran, Salina, Detroit River and Traverse formations and their faunal zones. Lower parts of both Systems have been little cored, and stratigraphers ask: Are there undiscovered buried reefs, related to later Saline deposition, that escaped erosion, Did Fort Wayne Bank have an Ohio extension on either flank of Findlay Arch, Might not oldest Devonian rocks in deep basin center be older than Oriskany, Is not the supposition correct that Bailey Limestone, presumed Devonian, might be in part Silurian, — GDC

01630 **Shaw, David M.; Donn, William L.** A thermodynamic study of Arctic paleoclimatology: Quaternary Research, v. 1, no. 2, p. 175-187, illus., tables, 1971.

Adem's thermodynamic model (1962-65) has been applied to the determination of Arctic and hemispheric surface temperatures with both ice-covered and ice-free states of the Arctic Ocean; the effects of glaciated and nonglaciated continents are included in the investigation. For an Arctic ice cover as at present, computed temperatures for the polar sea and northern hemisphere correspond closely with present observations. Over a broad range of critical parameters, removal of the ice cover yields temperatures well above freezing throughout the year; with continental glaciation, computed Arctic temperatures are depressed. — DBV

Shaw, Van E. *See* Huffman, Claude, Jr. 01422

01504 **Sheffy, M. V.; Dilcher, D. L.** Morphology and taxonomy of fungal spores: Palaeontographica, ser. B, v. 133, nos. 1-3, p. 34-51, illus., 1971.

Dispersed fungal spores are described from a clay deposit in the middle Eocene Claiborne Formation, near Puryear, Henry County, Tenn., from which Berry (1916) collected many fossil leaves. The spores are classified according to morphologic characteristics of spore shape, number of cells and apertures, and surface ornamentation, and this information is denoted in the generic and specific names; this nomenclatural system was followed by Hammen (1954) and others. Described and figured in this study are 76 species (70 new) under 14 form genera (4 new, 5 emended from Hammen, 1954 and Elsik, 1968). The new genera are *Didymoporisporonites*, *Tricellaesporonites*, *Staphlosporonites*, *Triporisporonites*. Resemblances to spores of natural taxa are noted for a few species. Because the spores were obtained from a limited sample, no stratigraphic or ecologic conclusions are attempted. — VMJ

01844 **Shegelski, R. J.** The general stratigraphy of Thunder Bay, Lake Superior [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 61, 1971.

08750 **Sheldon, Richard P.** Sedimentation of iron-rich rocks of Llandovery age (Lower Silurian) in the southern Appalachian Basin, *in* Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, p. 107-112, 1970.

Eastern beds in this basin indicate a land mass to the east during Llandovery time, corresponding to old "Appalachia", shedding sediments westward into shallow seas, to form the coarse-grained clastics that grade basinward into shales. The time-stratigraphic significance of a single episode of iron sedimentation for the "Clinton iron ore", between New York and Alabama, is not supported by paleontologic dating. Facies relations and chemistry point to marginal marine chemical deposition of iron derived by weathering of the eastern land mass. The relict Red Mountain Formation in the folded belt of Alabama, disconformable on eroded Chickamauga Limestone (Ordovician) and in beveled contact with overlying Frog Mountain Sandstone (Devonian), records minor Silurian sea fluctuations and pre-Devonian erosion. — GDC

01469 **Shelley, David.** Hypothesis to explain the preferred orientations of quartz and calcite produced during syntectonic recrystallization: Geol. Soc. America Bull., v. 82, no. 7, p. 1943-1954, illus., table, 1971.

The hypothesis presented in this paper explains the preferred orientations of quartz and calcite produced during syntectonic recrystallization, in terms of the preferential growth of grains that are stable with respect to the translation mechanisms operative in particular stress fields. The common preferred orientations of quartz and calcite, including "ac" girdles, cross-girdles, and the common maxima positions of quartz, can be correlated with predictions made by an analysis of stable growth orientations in various stress fields. Experimentally produced preferred orientations and two examples of natural quartz fabrics are used to illustrate the hypothesis. One of these, a mylonite from New Zealand, is treated in detail. It is shown that the mylonite results from simple flattening, and not from translational movements. — Author's abstract

Sheng, Harrison. *See* Stanley, Daniel J. 01466

01679 **Sheridan, M. F.; Stuckless, J. S.; Fodor, R. V.** A Tertiary silicic cauldron complex at the northern margin of the Basin and Range Province, central Arizona, U.S.A.: Bull. Volcanol., v. 34, no. 3, p. 649-662, illus., tables, 1971.

The primary structural elements of an eruptive center in the western part of the Superior volcanic field, in central Arizona between the southern Basin and Range Province and the Colorado Plateau Province, are (1) a volcanic plateau, (2) a ring fracture zone, and (3) a resurgent caldera zone. A NW-trending graben controls the location of three small cauldrons which were centers for rhyolite ash and lava eruption. These late features are superposed on the much larger Superstition resurgent cauldron which subsided earlier following the extrusion of quartz latite welded tuff. The history of the volcanic center is outlined. — DBV

Sheridan, Robert E. *See* Kraft, John C. 01793

01646 **Shimoda, S.; Brydon, J. E.** I.R. studies of some interstratified minerals of mica and montmorillonite [with French, German, and Russian abstracts]: Clays and Clay Minerals, v. 19, no. 1, p. 61-66, illus., table, 1971.

[In this paper, thermally induced shifts in characteristic absorption bands of a variety of interstratified minerals and of monomineralic type clay specimens are discussed in relation to previously published data.] Infra-red band shifts in the 830, 750 and 530 cm^{-1} regions that occur in interstratified layer silicates on heating were used to characterize the nature of the component layers. Two specimens showed shifts characteristic of 1M illite and montmorillonite. Another specimen was similar to 2 M illite even though the proportion of expanding layers was 0.4. The shifts for rectorite and allevardite resembled those of paragonite and 2M illite. — Authors' abstract

Shows, Thad N. *See* Baughman, Wilbur T. 01769

01939 **Silvester, Richard; Mogridge, Geoffrey R.** Reach of waves to the bed of the Continental Shelf, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 651-667, illus., table [1971].

The physiography of continental shelves and their major composition of sediment indicate strongly their terrigenous origin and their smoothing by wave action. This premise is supported by the geologic time over which waves have existed and the mass-transport velocity in these relatively shallow depths, particularly the net movement within the wave boundary layer at the bed. A given wave train arriving obliquely to the shore can support material along the coast, both beyond the breaker line and within the surf zone. It is shown that for equal over-all discharge in the two zones, the average sediment concentration offshore close to the bed need be reasonably small, indicating that transport near the beach could be a fraction of that from the breakers to the reach of the waves. This latter limit is shown to extend at least half way across the shelf, with possibilities of a greater reach when more realistic prototype conditions are introduced into experiments. — Authors' abstract

Sims, P. K. *See* Viswanathan, S. 01847

Sims, P. K. *See* Ojakangas, R. W. 01851

Singer, T. E. R. *See* Maizell, Robert E. 01585

01961 **Sinkankas, John.** Mexico's mineral classics: Mineral Digest, v. 1, p. 7-16, illus. [1971?].

Classic minerals are those of the first or highest class or rank; of representative excellence. To encourage collectors to obtain Mexican specimens of high quality, now, brief notes on 40 of the more remarkable species are given including color photographs of eight. Possible future deposits in Mexico are presented. — ESL

01539 **Slatkin, Montgomery W.** Long waves generated by ground motion: Jour. Fluid Mechanics, v. 48, pt. 1, p. 81-90, 1971.

The initial-value problem for waves generated y ground motion near a shore is solved using linear shallow water theory and an exponential bottom profile. It is found that long waves can be trapped along the coast and travel with the deep water wave speed $(gh)^{0.5}$. The energy in these waves decays with $X^{-0.5}$ instead of X^{-1} so that more energy could be observed on this coast than expected on the basis of deep water wave amplitudes. — Author's abstract

01515 **Slavina, L. B.** O zavisimosti opredeleniya polozheniya epitsentra zemletryaseniya ot raspolozheniya stantsiy i ot osobennostey vremen probega P-voln [On the dependence of determination of the location of an earthquake epicenter on the disposition of stations and on the particulars of P-wave travel times]: Akad. Nauk SSSR Izv. Fiziki Zemli, no. 2, p. 77-87, illus., tables, 1971.

Using data for the 1964 Alaska earthquake and an Aleutian explosion, this paper examines determination of epicentral coordinates from a system of more than 40 stations surrounding the epicenter, from one of less than 20 stations surrounding the epicenter, and from one of stations in a narrow azimuth relative to the epicenter. Best results are obtained both by using a large number of stations in the world network, well distributed around the epicenter, and with a smaller number of such stations, if they have minimal corrections and are evenly distributed around the epicenter. Increasing the number of stations does not increase accuracy. When stations are distributed more or less in one azimuth from the epicenter, epicentral coordinates may be displaced. The trend of corrections mainly obeys a low of variation with distance; station corrections can be introduced for any station by using the $f = \Phi(\Delta^\circ)$ curve. — DBV

01669 **Smith, J. E.** Relationship between petroleum reservoir rocks and source rocks: Internat. Assoc. Math. Geology Jour., v. 3, no. 2, p. 183-192, illus., table, 1971.

A substantial fraction of sandstones containing commercial quantities of oil are proposed to be in contact with source rocks which produce oil. For these situations the quantity of oil collected in a sandstone is proportional to the area of contact with a source rock of relatively low permeability, rather than to the total thickness of the potential source rock. It is inferred that source rocks along the upper or lower faces of a sandstone should produce more oil into the sandstone than source rocks lateral to the sandstone. Semiquantitative estimates of the thickness or width of required source rock are obtained. The arguments and results are based on published statistical studies and the assumption that a degree of geometrical similarity exists among sandstones. — Author's abstract

Smith, Julian F. *See* Maizell, Robert E. 01585

Smith, W. D. M. *See* Guy, James O. 02040

01928 **Snodgrass, Marjorie P.** Waste disposal and treatment in permafrost areas — A bibliography: U.S. Dept. Interior Off. Library Services Bibliog Ser. 22, 28 p., 1971.

This bibliography lists 172 references, chiefly in English and dated from 1940 to 1969, related to waste collection, treatment, and disposal in permafrost and discontinuous permafrost areas. — EH

01750 **Soga, Naohiro.** Sound velocity of some germanate compounds and its relation to the law of corresponding states: Jour. Geophys. Research, v. 76, no. 17, p. 3983-3989, illus., tables, 1971.

The compressional and shear velocities of polycrystalline germanates were measured at room temperature by the ultrasonic pulse transmission method. The values of v_p and v_s at zero porosity were estimated from these data to be 4.1 and 2.55 kmps for GeO_2 (quartz), 7.9 and 4.85 kmps for GeO_2 (rutile), and 7.4 and 4.4 kmps for Mg_2GeO_4 (olivine). These results were used with existing data on silicate compounds to formulate the empirical relationships of sound velocity, density, and mean atomic weight and also used to estimate the value of m in the mantle. — Author's abstract

01562 **Somasiri, S.; Lee, S. Y.; Huang, P. M.** Influence of certain pedogenic factors on potassium reserves of selected Canadian prairie soils: Soil Sci. Soc. America Proc., v. 35, no. 3, p. 500-505, illus., tables, 1971.

The nature of K reserves of five prairie soil profiles in Saskatchewan, Canada was studied. The total K in various size fractions was allocated to mica and feldspar. The fraction of K from feldspar and mica varied with particle size and parent material. The effects of climate, topography, and drainage on the nature of soil K reserves were apparent. — Soil Brief

01960 **Sonu, Choule J.; Young, Myron H.** Stochastic analysis of beach profile data, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1341-1363, illus., table [1971].

Stochastic prediction of beach changes by means of a linear least-squares transfer function requires a knowledge of power spectra. An attempt was made to generate data artificially by a Monte Carlo simulation. A beach profile transition model which considers the profile as a dynamic system allows beach width, sediment storage, and surface configuration to be determined in successive profiles and simulates beach cycles associated with random waves which agree sufficiently with actual observation. The simulated data are amenable to standard stochastic analysis to yield power spectra, cross spectra, coherence functions, and phase lags. Comparison of results with those derived from actual data shows reasonable agreement. — *from* Authors' abstract

Sörensen, Poul. *See* Lövborg, Leif. 01501

Sörensen, Torben. *See* Dyhr-Nielsen, M. 01948

Sorenson, Robert M. *See* Wells, Donald R. 01957

01491 **Souchez, R. A.** Ice-cored moraines in south-western Ellesmere Island, N.W.T., Canada: Jour. Glaciology, v. 10, no. 59, p. 245-254, illus., tables, 1971.

The northwest margin of the main icecap in southwestern Ellesmere Island is fringed by ice-cored moraines. The formation of these moraines seems to be more complex than simple upwarping of the foliation bands at the margin of the ice cap. At one locality, where outer and inner zones can be distinguished on the basis of lithological composition, debris in the outer zone is composed of material from farther back under the ice cap than debris in the inner zone. In another locality, localized ridges cross each other independently of the trend of the main ridge. The time required to obtain the quantity of debris forming the moraine at the ice surface is estimated to be between 65 and 200 years. — Author's abstract

01673 **Southard, John B.; Dingler, John R.** Flume study of ripple propagation behind mounds on flat sand beds: Sedimentology, v. 16, no. 3-4, p. 251-263, illus., table, 1971.

Propagation of sediment ripples behind mounds of sediment in uniform flows of water over flat beds of fine sand was studied in a recirculating open channel. If flow is strong enough, scour downstream of the mound, due to flow separation and impingement of strong eddies on the bed, generates a ripple which grows large enough to cause downstream scour and another ripple; the result is a widening train of ripples. On the theory that ripple development is governed by the relation between minimum height of bed irregularity necessary to generate ripples on an otherwise flat bed and maximum height that can be built up by flow over an originally flat bed, minimum mound height for propagation of ripples was found to be non-zero even when some sediment moved on the surrounding flat bed; lack of spontaneous development of ripples under these conditions suggests there is a range of bed shear stresses for which a flat bed in uniform flow is metastable. — GDC

Spannagel, G. *See* Fireman, E. L. 01757

01790 **Sparling, Dale R.** Bedrock geology of Ottawa County, Ohio, *in* Michigan Basin Geol. Soc. Ann. Field Excursion, 1971 [Guidebook] — Geology of the Lake Erie Islands and adjacent shores: [East Lansing?, Mich.] Michigan Basin Geol. Soc., p. 19-29, illus., 1971.

Summarized are views on Late Silurian to Middle Devonian history of this area on the eastern flank of Findlay Arch, a positive tectonic influence for sedimentation. A generalized map of bedrock geology is based on the author's field and subsurface studies, well data from U.S. Gypsum Company and Ohio Div. Water, and on Mohr (1931) and Hartley (1961). Described in outline, noting faunal zones, are: the Lockport Dolomite; Bass Islands Fm. and its Greenfield Dolomite, gypsiferous Tymochtee, dolomitic Put-in-Bay and Rain River members; Detroit River Group of Amherstburg and Lucas Dolomites; and Columbus Limestone. The suggested sequence is: Lockport sedimentation at centers of three basins drained after the Niagaran cycle, with differential submergence involving biostromal reefs; hypersaline Bass Islands deposition; eroded, breccia; normal marine Early Devonian; Lucas seas restricted by coral bioherms; and again normal marine for Columbus Limestone. — GDC

01845 **Spencer, G.** Chert in sediments [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 62-63, 1971.

01610 **Spieker, Edmund M.** Schöpf, Maclure, Werner, and the earliest work on American geology: Science, v. 172, no. 3990, p. 1333-1334, 1971.

Schopf produced the first substantial report on the geology of North America, a work that has long suffered unjustified oblivion. In at least one feature this treatise is superior to that of Maclure (the "Father of American Geology") — Schopf attempted interpretation whereas Maclure did not. The suggestion is here offered that Maclure, who adopted Werner's classification of the stratigraphic succession, was simply shying away from Wernerian interpretation because he did not like the looks of it. — Author's abstract

01902 **Springer, G.; Laflamme, J. H. G.** The system Bi_2S_3-Sb_2S_3: Canadian Mineralogist, v. 10, pt. 5, p. 847-853, illus., 1971.

The phase relations in the system Bi_2S_3-Sb_2S_3 were determined at temperatures between 200° and 800°C by means of quenching and DTA experiments using silica tubes as sample containers. Complete solubility between Bi_2S_3-Sb_2S_3 was found in the solid as well as the liquid states. Since compositions between $(Bi_{0.45}Sb_{0.55})_2S_3$ and Sb_2S_3 have not been detected among naturally occurring members of this solid solution series, it is presumed that the deposition of stibnite (Sb_2S_3) and bismuthinite (Bi_2S_3) occurs under completely dissimilar conditions in nature. — Authors' abstract

01772 **Srinivasan, B.; Alexander, E. C., Jr.; Manuel, O. K.** Iodine-129 in terrestrial ores: Science, v. 173, no. 3994, p. 327-328, table, 1971.

Xenon entracted from natural iodyrite (silver iodide) from Broken Hill, New South Wales, Australia, contains excess xenon-129 from the in situ decay of naturally occurring iodine-129 and excess xenon-128 from neutron capture on iodine-127. On the basis of the amount of radiogenic xenon-129, it is estimated that, prior to the nuclear age, terrestrial iodine contained an equilibrium ratio of iodine-129 to iodine-127 of between 3.3×10^{-15} and 2.2×10^{-13}. — Authors' abstract

01670 **Srivastava, G. S.; Sackin, M. J.** AUTO, a FORTRAN IV program for autoassociation: Internat. Assoc. Math. Geology Jour., v. 3, no. 2, p. 193-202, illus., 1971.

A FORTRAN IV program for autoassociation as applied to geologic data and using a GE635 computer is described. Autoassociation is a method for self-comparison of a string or sequence of non-numeric data. Geologic data for autoassociation may be some coded aspect of lithology in a stratigraphic section. The method allows several different properties to be recorded for each position of the primary data. — *from* Authors' abstract

01466 **Stanley, Daniel J.; Sheng, Harrison; Pedraza, Carlos P.** Lower continental rise east of the Middle Atlantic States — Predominant sediment dispersal perpendicular to isobaths: Geol. Soc. America Bull., v. 82, no. 7, p. 1831-1839, 1971.

The lower continental rise east of the Middle Atlantic United States consists of a series of megafans and well-defined levee-bounded giant valleys meandering across the surfaces of the fans. This region lies below the southwest-flowing Western Boundary Undercurrent, but morphologic features observed are best explained by dominant long-term, gravity-induced, downslope sediment transport processes. Sediment dispersal by contour currents flowing parallel to isobaths, recently described, clearly has not been a significant factor in shaping this sector of the lower rise. — Authors' abstract

01489 **Stanley, Daniel J.; Pierce, Jack W.** Readings in suspended sediment technology — Suspended sediment studies and growth in the 1970's, *in* The *new* concepts of continental margin sedimentation, application to the geological record — AGI Short Course Lecture Notes, Houston, Tex., 1971, Suppl. (D. J. Stanley, editor): Washington, D.C., American Geological Institute, 7 p., 1971.

One area of marine sedimentology that is advancing faster than any other is the one pertaining to suspended sediment. Silt and clay are the most important components of outer continental margin deposits; they cover a large part of the abyssal areas, and also constitute the bulk of sedimentary rocks. Probably the reason fine-sediment transport has been neglected is the difficulty in getting uncontaminated samples of sufficient volume, and lack of a technology for processing large-volume water samples. The problems of waste disposal and pollution are turning scientific studies to more emphasis on suspended sediment. A selected bibliography of 80 references is included. — ESL

01513 **Stanley, Daniel J.** (editor). The *new* concepts of continental margin sedimentation, application to the geological record — AGI Short Course Lecture Notes, Houston, Tex., 1971, Suppl.: Washington, D.C., American Geological Institute, [61] p., illus., table, 1971.

The role of calcium carbonate deposition on continental shelves is discussed in a lecture cited separately, and notes on suspended sediment studies with a listing of bibliographic citations is also cited separately. The supplement also contains a subject index for the 15 lectures and a corrections-additions list to the 1969 volume. — ESL

Stanley, Daniel J. *See* Swift, Donald J. P. 01551

01657 **Starfield, A. M.** The elastic behavior of large rock masses: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 50-61, illus., 1971.

Elastic analysis is the first step in a study of the behavior of the mass surrounding an excavation. Some general results from the theory of elasticity are useful in any such study. This paper considers harmonic and biharmonic functions and the application of harmonic functions, the analogy for tabular ore bodies, the electrical resistance analog, and digital computermethods. Problems which can be solved by elastic analysis are mentioned. — DBV

01658 **Starfield, A. M.; Wawersik, W. R.** Pillars as structural components in room and pillar mine design: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 62-82, illus., table, 1971.

Pillar stability is discussed as the interaction between the pillars and the surrounding rock in a mine. A computer model is suggested for calculating this interaction, and a qualitative understanding of the behavior of mine pillars has been obtained from compression tests in a stiff testing machine. The validity of this approach must be determined from comparisons of computer predictions with measurements in place. Once the computer model has been adjusted to real conditions, it should be of considerable use in obtaining sufficient simulated "experience" to develop general design principles, in comparing relative merits of proposed mine designs, or in indicating the possible influence of a particular geologic condition on the stability of a mine layout. — DBV

01544 **Steele, William K.** Paleomagnetic directions from the Iztaccihuatl volcano, Mexico: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 211-218, illus., tables, 1971.

Measurement of partially demagnetized samples from 35 sites above timberline on Iztaccihuatl, a late Cenozoic volcano 60 km southeast of Mexico City, revealed the normal polarity of the lava flows. Most of the lavas are andesites, but some are basaltic flows. The popularly called 'Sleeping Lady' is morphologically divided into four units, each of which appears to consist of flows from a different vent. Subjected to past intense glaciation and more recent high rainfall, the erosional sculpturing makes difficult the interpretation of its volcanic history. The flows decrease in age from south to north with some overlap in those from the Knees and Breast; the Feet volcano is most highly eroded and is considered Tertiary in age (Mooser, 1963). Normal polarity data are consistent with, but not sufficient proof of Mooser's theory that the other units originated in the Quaternary, which is contradicted by the improbable 13.3 m.y. K-Ar age for the Knees. — GDC

01493 **Stehli, Francis G.; Wells, John W.** Diversity and age patterns in hermatypic corals: Systematic Zoology, v. 20, no. 1, p. 115-126, illus., 1971.

Diversity and average generic age distributions for hermatypic corals show that while the Atlantic and Indo-Pacific faunas have evolved at different rates and in some respects have long been isolated systems, many responses to environment are the same. In each ocean, the diversity is highest north of the equator and in the western portion of the ocean. Positive anomalies in mean annual sea surface temperature are closely associated with maximum diversity and with minimum average generic age and a general relationship between both parameters and the area suitable for hermatypic coral growth is also evident. The data suggest that evolution of new genera is proceeding most rapidly in the regions of warmest water, but it is not possible to separate from the temperature relationship the affect of area of favorable bottom which cannot yet be quantified. — Authors' abstract

Stemprok, Miroslav. *See* Pouba, Zdenek. 08766

Sterling, David A. *See* Malan, Roger C. 01834

Sternberg, Richard W. *See* Kachel, Nancy B. 01705

02051 **Stevenson, F. J.; Goh, K. M.** Infrared spectra of humic acids and related substances: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 471-483, illus., table, 1971.

Humic and fulvic acids from several sources were separated into three spectral types depending upon their infrared absorption characteristics. Those belonging to Type I showed equally strong bands at 1720 and 1600 cm^{-1}, with no discernible absorption being evident at 1640 cm^{-1}. A distinguishing characteristic of the preparations giving spectra of Type II was a very strong 1720 cm^{-1} band, a shoulder at 1650 cm^{-1}, and the absence of a 1600 cm^{-1} band. The preparations of Type III showed pronounced bands indicative of proteins and carbohydrates. Observed spectral changes in the 1700-1600 cm^{-1} region indicated that the humification process consisted, in part, of a loss of COOH groups and a change in the environment of C = O from the free or weakly H-bonded state to strongly chelated forms. — Authors' abstract

01940 **Stiles, Newell T.; Wiesnet, Donald R.** Isopachous mapping of the lower Patuxent Estuary sediments by continuous seismic profiling techniques, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 669-686, illus., table [1971].

Thickness and extent of the sediment cover in the Patuxent Estuary has been determined using a high-frequency, high-spatial resolution, shallow-penetration, continuous seismic profiling system. From these data an isopachous map was prepared which provides subbottom information required to determine optimum locations for placing test equipment on the river bottom. Mud-filled depressions, up to 16 feet thick and acoustically transparent to 12-kH_z sound pulses, occur mainly north of Half Pone Point and east of the present channel. Dominance of the thicker deposits east of the channel and evidence of a submerged terrace indicate that the channel has migrated to the west or was larger in the past and has subsequently filled in much of the eastern edge. Maximum penetration at the scarp of the terrace was 36 feet beneath the water-sediment interface. This study demonstrates coastal engineering applications of seismic profiling techniques. — *from* Authors' abstract

Stoenner, R. W. *See* Norton, Elinor F. 01779

Stoenner, R. W. *See* Forman, Miriam A. 01877

01500 **Stollery, G.; Borcsik, M.; Holland, H. D.** Chlorine in intrusives — A possible prospecting tool: Econ. Geology, v. 66, no. 3, p. 361-367, illus., table, 1971.

The average chlorine content of biotites and of the bulk granite of the Providencia stock is 2 to 3 times that of average granitic rocks and their biotites. Quartz of the stock contains highly saline fluid inclusions. Because ore metals are concentrated from silicate melts into highly saline aqueous fluids, a relatively large chlorine content may well be a necessary, though not the sole prerequisite for the formation of associated magmatic-hydrothermal ore deposits. The chlorine content of intrusive rocks may become a useful prospecting tool. — *from* Authors' abstract

01909 **Stone, Richard O.** Formation and localization of mineral deposits: Jour. West, v. 10, no. 1, p. 5-22, illus., 1971.

Background information includes the fact that most metallic ore deposits occur in, or near, areas where magma cooled a few miles below the surface. Mineral deposits are classified into syngenetic and secondary; the first including magmatic segregation, epigenetic, pegmatites, contact metamorphism, and hydrothermal; the second, residual and supergene enrichment. Major causes of localization of bodies and metallogenetic provinces are discussed. The final section covers ore deposits in relation to recent developments in tectonics such as sea-floor spreading and plate tectonics. — ESL

01812 **Stormer, J. C.; Carmichael, I. S. E.** Fluorine-hydroxyl exchange in apatite and biotite — A potential igneous geothermometer: Contr. Mineralogy and Petrology, v. 31, no. 2, p. 121-131, illus., tables, 1971.

The free energy data for the simple fluorides, chlorides, and hydroxides have been used to predict distribution of anions in hydrous minerals. The calculated partition of fluorine in phlogopite agrees well with published results; distribution of fluorine and hydroxyl between apatite and phlogopite is temperature dependent and has been calculated. Temperatures deduced from analyses of natural apatite-biotite pairs frequently show discrepancies as compared with independent temperature estimates; these probably arise from late-stage exchange of fluorine in phylogopite with an aqueous fluid, for which independent evidence is available. The fugacity of phosphorus in equilibrium with apatite, a ubiquitous hydrous mineral, has been calculated for various mineral assemblages. Estimates, which are subject to considerable error, are lower for basanites and alkali-basalts than for tholeiites and range from approximately 10^{-14} bars at 1,000°C to 10^{-16} bars at 750°C for fayalitic rhyolites. — Authors' abstract

Stout, M. L. *See* Merifield, Paul M. 01475

Strangway, D. W. *See* York, D. 01605

Street, Robert L. *See* Mogel, Theodor R. 02002

Stringfield, V. T. *See* LeGrand, Harry E. 01786

01762 **Struble, Richard A.; Collins, Horace R.; Kohout, Douglas L.** Deep-core investigation of low-sulfur coal possibilities in southeastern Ohio: Ohio Div. Geol. Survey Rept. Inv. 81, 29 p., illus., tables, 1971.

This investigation of deep, low-sulfur coal possibilities in southeastern Ohio was confined to those counties bordering the Ohio River in which coal has been produced at certain levels but in which there has been little deep production. Cores were taken at widely-spaced intervals starting below the stratigraphic position of the higher coals. Coal sections of these cores, more than 28 inches thick, were correlated and chemically analyzed. Maps of coal thickness and interpreted distribution were compiled for each significant coal layer. The authors conclude that no new low-sulfur coal reserves were found or probably will be found in the deep portion of the Ohio basin. However, the presence of deep coal, though not necessarily low-sulfur coal, is indicated in some areas. — EH

Stuckless, J. S. *See* Sheridan, M. F. 01679

08742 **Stuiver, M.** Long-term C-14 variations, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 197-213, illus., table, 1970.

Lake-sedimentation rates and lake-varve chronology provide information on long-term atmospheric C-14 changes. Variations in average sedimentation rate, expressed in C-14 years, are about 20 percent for the interval between 4,000 and 9,000 C-14 yr B.P. This suggests that the magnitude of long-term atmospheric C-14 changes is probably also restricted to about 20 percent over the same interval. Varve chronology of sediments from Lake of the Clouds, Minnesota, gives differences between C-14 and varve ages of less than 800 yr over the 10,000 varve-yr interval. Variations in atmospheric C-14 activity suggested by this chronology are in agreement with the hypothesis that changes in earth magnetic-dipole moment are important factors causing long-term atmospheric C-14 variations. The Lake of the Clouds chronology suggests an error at least +600 yr in the De Geer varve chronology in Sweden. A possible reversion in the C-14 time-scale about 20,000 C-14 yr ago is perhaps associated with the Laschamp magnetic-polarity reversal. — *from* Author's abstract

01969 **Stuiver, Minze.** Evidence for the variation of atmospheric C^{14} content in the late Quaternary, *in* The Late Cenozoic glacial ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 57-70, illus., table, 1971.

The evidence is reviewed for late Quaternary C-14 variations obtained from tree rings, historically dated samples, varves, lake sedimentation rates, chronological distribution of C-14 dates, and time reversals. Excellent agreement is found for the various methods over the past 7500 calendar years. New data for the Lake of the Clouds varve chronology disagree with the Swedish varve chronology for the interval of 7500-10,000 years b.p. The end of the Laschamp magnetic polarity event is tentatively dated at 20,000 yr b.p. — Author's summary

Stump, Edmund. *See* Armstrong, Richard Lee. 01713

08745 **Suess, H. E.** The three causes of the secular C-14 fluctuations, their amplitudes and time constants, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 595-604, discussion, p. 604-605, illus., 1970.

Explanations for variations of C-14 level in atmospheric carbon dioxide may be sought in changes: in C-14 production rate due to changes in intensity of the geomagnetic field; in production rate due to modulation of cosmic-ray flux by solar activity; and in geochemical radiocarbon reservoirs and rates of carbon transfer between them. Bristlecone-pine wood measurements from the past seven millenia show a long-term change of 10 percent of the C-14 level in 10,000 yr. This requires a 50 percent change in C-14 production rate in line with a change by a factor of about 2 in geomagnetic field intensity. Statistically significant correlations are found between sunspot numbers and atmospheric C-14 level for the past three centuries. Variations in C-14 inventory of about 3 percent necessitate changes in C-14 production rate of about 50 percent. Possible explanations for empirical correlations with climatic changes are: effect of climatic change on geochemical radiocarbon reservoirs, and a simultaneous effect of the sun state on climate and rate of radiocarbon production. — *from* Author's abstract

01896 **Sutherland, J. K.** A second occurrence of dzhalindite: Canadian Mineralogist, v. 10, pt. 5, p. 781-786, illus., table, 1971.

Dzhalindite ($In(OH)_3$) has been discovered at Mount Pleasant, New Brunswick, Canada, where it is associated with calcite, galena, and quartz in fractures in sphalerite containing exsolved chalcopyrite and stannite. Electron microprobe analyses indicate substitution of indium by tin (7.4 wt. percent), zinc (1.6 wt. percent), and iron (1.7 wt. percent). — Author's abstract

01970 **Swanson, S. R.; Brown, W. S.** An observation of loading path independence of fracture in rock: Internat. Jour. Rock Mechanics and Mining Sci., v. 8, no. 3, p. 277-281, illus., 1971.

The effect of stress loading path on fracture or maximum stress is investigated for several rocks [Westerly Granite and a Cedar City, Utah, quartz diorite or tonalite]. A special testing apparatus constructed for this study is described. This apparatus used conventional cylindrical specimens under pressures up to 7 kb, but with the unique features that the ratio of the two independent principal stresses could be controlled by means of electrohydraulic servo-systems, thus controlling the stress loading path. The fundamental result observed is that the maximum stresses in all rocks tested are independent of the stress loading path. Results from one-dimensional strain tests, carried out by means of the servo-controlled apparatus, are also presented. — Authors' abstract

01741 **Sweet, Palmer C.** Gold mines and prospects in Virginia: Virginia Minerals, v. 17, no. 3, p. 25-33, illus., table, 1971.

Brief summaries are given of some of the major gold mines and prospects in the gold-pyrite belt and isolated localities in Virginia. Both lode and placer mines have existed at various times. — EH

01545 **Sweet, Walter C.; Bates, Robert L.; Maccini, John A.** An audio-visual tutorial laboratory: Jour. Geol. Education, v. 19, no. 3, p. 107-111, illus., 1971.

An audio-visual-tutorial (AVT) program was devised to correct shortcomings in the laboratory work of an introductory geology course developed at Ohio State University. Laboratory material, which includes slides, sound films and actual specimens, is programmed so that a student can work at his own rate. The program consists of nine self-contained units each of which builds on experiences of previous laboratory work. The program was well-received by the students, was found to be successful from an educational point of view, and was easy to evaluate. — EH

01551 **Swift, Donald J. P.; Stanley, Daniel J.; Curray, Joseph R.** Relict sediments on continental shelves — A reconsideration: Jour. Geology, v. 79, no. 3, p. 322-346, illus., 1971.

Recent studies have revealed a set of attributes which indicate that relict sediments on shelves, although originating in an earlier environment, are dynamic systems which are undergoing modification in response to their present environment, especially the hydraulic regime, and are approaching a state of equilibrium with this environment. The modification may be simulated by a stochastic process model. A spectrum of modern shelf regims and resulting deposits is considered here. Relict sediment is a valuable genetic name for the unreworked sediment type, and palimpsest sediment is a descriptive term for reworked parts. A palimpsest sediment is one which exhibits petrographic attributes of an earlier depositional environment and, in addition, petrographic attributes of a later environment. Intermediate stages are possible from pure relict, through palimpsest to modern autochthonous sediments. — *from* Authors' abstract

01672 **Swift, Donald J. P.; Sanford, Robert B.; Dill, Charles E., Jr.; Avignone, Nicholas F.** Textural differentiation on the shore face during erosional retreat of an unconsolidated coast, Cape Henry to Cape Hatteras, western North Atlantic Shelf: Sedimentology, v. 16, no. 3-4, p. 221-250, illus., table, 1971.

A grain-size analysis was made of samples from this Virginia-North Carolina coast to evaluate a Holocene shelf sediment distribution model in nearshore modern and offshore relict sand facies. Textural provinces erected include medium-grained beach and surf zones, seaward fining shore face, and heterogenous sea floor of ridges and swales with coarser grains on crests. For coast-wise trends, wave heights are assumed to increase southward. Evidence for a former Albemarle River channel bisects the study area. Studies indicate almost continuous retreat of barrier superstructures by upper shore-face erosion and storm-wash, and lower shore-face erosion with equal-volume aggradation of adjacent sea floor into leading edge of a transgressive sheet sand. This is referred to as a Holocene barrier sand prism, since both nearshore and offshore sands are relict as derived from a Pleistocene substrate, and modern in adjustment to hydraulic regime. — GDC

02021 **Sylvester-Bradley, Peter C.; Benson, Richard H.** Terminology for surface features in ornate ostracodes: Lethaia, v. 4, no. 3, p. 249-286, illus., 1971.

The surface ornament of the ostracode carapace is shown to be composed of structural elements extending into the thickness of the shell. A terminology is proposed for surface features newly revealed by scanning electron microscopy. — Authors' abstract

01524 **Symons, D. T. A.** Paleomagnetism of the Jurassic Island Intrusions of Vancouver Island, British Columbia: Canada Geol. Survey Paper 70-63, p. 1-17, illus., tables, 1971.

Granodioritic batholiths of mid-Jurassic Island Intrusions were sampled at 24 sites (218 specimens) along Vancouver Island; 17 sites were judged to have stable primary TRM with 16 sites reflecting a normal mid-Jurassic paleomagnetic field and one site a reversed field. Use of the fold test indicates that the broad anticlinorium found in Triassic Karmutsen basalts was formed prior to cooling of the Island Intrusions. The calculated geomagnetic pole position for the Intrusions of 79°N., 240°E. is consistent with positions for other North American Jurassic rock formations indicating no, or very little, post-intrusion movement of Vancouver Island relative to the North Amer-

ican continental block. Any minor movement can be explained by a few degrees (about 15°) of clockwise rotation of the island during the mid-Cretaceous Nevadan Orogeny or Tertiary sea-floor spreading off the East Pacific Rise, and by a few degrees (about 5°) of northeastward tilt of rock panels between block faults. — *from* Author's abstract

01604 **Symons, D. T. A.** A paleomagnetic study of the Nipissing diabase Blind River-Elliot Lake area, Ontario: Canada Geol. Survey Paper 70-63, p. 19-30, illus., tables, 1971.

This study is based on paleomagnetic properties of 200 specimens from 11 sites in 3 sill-like sheets and 8 sites in 8 dikes of Nipissing diabase in the Blind River-Elliot Lake area. Weak stable remanence components were isolated for several sites. Remanence directions and available radiometric ages suggest that the Nipissing sheets were emplaced and/or cooled during several polarity intervals about 2,155 m.y. ago while the Aphebian Huronian sedimentary host rocks were being folded and that the sheets were intruded contemporaneously with the Nipissing sill at Cobalt, Ontario. The 'Nipissing' dikes were emplaced after folding of Huronian sediments and intrusion of the sheets probably during a polarity interval about 1,995 m.y. ago. Pole positions for sheets and dikes are 98°W., 1°S. and 131°W., 36°N., respectively. Polar wandering relative to the Superior Structural Province appears to have occurred at a rate consistent with that relative to North America during younger eras. — *from* Author's abstract.

01602 **Szabo, Barney J.; Vedder, John G.** Uranium-series dating of some Pleistocene marine deposits in southern California: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 283-290, illus., tables, 1971.

Analyses of uranium isotopes and their long-lived daughter products showed evidence of uranium migration in most of the 22 fossil mollusk shell samples from marine terrace deposits in southern California. Two samples remained an ideal closed system as indicated by concordant Th-230:U-234 and Pa-231:U-235 dates. The closed-system age of the lowest exposed marine terrace deposit along part of the mainland coast of southern California is 69,000 ± 10,000 yr, and correlation of this discontinuous deposit is afforded between the Newport Beach-Laguna Beach area and the Palos Verdes Hills. Some mollusk shell samples were dated by the open-system model; the remaining samples were found to be unsuitable for uranium-series dating. — Author's abstract

01614 **Szczechura, Janina.** Paleocene Ostracoda from Nügssuaq, West Greenland: Medd. Grönland, v. 193, no. 1, 42 p., illus., 1971; *reprinted as* Grönlands Geol. Undersögelse Bull. 94, 1971.

The first post-Paleozoic ostracodes reported from Greenland are described from the Paleocene (Danian) Agatdal Formation, which has yielded a huge fauna including more than 400 molluscan species. The 96 ostracode specimens belong to 39 species in 24 genera of suborders Cladocopina, Platycopina, and Podocopina. Four species are new: *Bairdia agatdalensis*, *Cushmanidea rosenkrantzi*, *Hazelina nova*, *Loxoconcha groenlandica*; others are unnamed or tentatively assigned. Age ranges of the genera are highly varied: *Orthonotacythere* ranges from Jurassic to Paleocene; *Sclerochilus*, ranging to Holocene, was not previously known earlier than Miocene; others range from Jurassic, Cretaceous, or Paleocene to Holocene. As no specimen could be assigned with certainty to previously described species, the assemblage is considered endemic and does not clarify the age of the Agatdal. — VMJ

01464 **Tabor, Rowland W.** Origin of ridge-top depressions by large-scale creep in the Olympic Mountains, Washington: Geol. Soc. America Bull., v. 82, no. 7, p. 1811-1822, illus., 1971.

In the high mountain area of the Olympic Mountains, Washington, there are many troughlike depressions on and essentially parallel to ridge tops. The troughs are mostly developed on rocks with strong planar anisotropy: slate, sandstone, and phyllite. Many depressions parallel structure; one wall is steeply dipping rocks, the other shattered, gently dipping rocks. These depressions seem to be the gaps left between

undisturbed steeply dipping rocks and beds or cleavage bent valleyward by creep. A few troughs may be the result of slow down-slope movement along deep-seated shear planes. The Olympic ridge-top depressions testify to the importance of gravity in the degradation of high mountains carved from weak rocks. — *from* Author's abstract

Talwani, M. *See* Pitman, W. C., 3d. 01541

Tamburi, A. J. *See* Lyons, J. B. 01619

01846 **Tan, F. C.; Perry, E. C., Jr.** Implications of carbon isotope ratio variations in carbonates from the Biwabik Iron-Formation, Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 64-65, 1971.

Tanner, James T. *See* Lombard, S. M. 01780

01797 **Tanner, William F.** Numerical estimates of ancient waves, water depth and fetch: Sedimentology, v. 16, nos. 1-2, p. 71-88, illus., tables, 1971.

Marine experiments, in which sand of known grain diameter and essentially perfect sorting was exposed to waves of various sizes, was supplemented by study of lakes of various widths to obtain relations between parameters measurable in sedimentary rocks and paleogeographic information. Results were subjected to regression analysis. Two equations were obtained relating ripple-mark spacing to grain size; water wave-length and water depth, with predictive abilities higher than 80 percent; and two relating ripple-mark spacing to grain size, water wave-height and water depth, with predictive ability of 75-80 percent. In general those based on water wave-length were superior to those on water wave-height. In shallow-water work, pairs of values obtained from equations are highly limited in range and thus define paleogeographic unknowns reasonably closely. Application is made to Jurassic rocks in northern New Mexico. — *from* Author's abstract

01509 **Taubeneck, William H.** Idaho batholith and its southern extension: Geol. Soc. America Bull., v. 82, no. 7, p. 1899-1928, illus., tables, 1971.

The Idaho batholith is more complex than most published descriptions suggest. Granitic rocks of southwestern Idaho are correlated with the batholith. The locations of the southern and southeastern contacts of the batholith are uncertain. Northward continuity of the Sierra Nevada batholith to the Nevada-Oregon boundary is well established, and its trend bends northeast before the batholith disappears under Cenozoic volcanic rocks in southeastern Oregon and northern Nevada. Relations in northernmost Nevada indicate that the Sierra Nevada batholith may connect with the Idaho batholith. An appreciable east-west change, as much as 50 mi, has occurred in the relative positions of the two batholiths since Oligocene time. Gravity and seismic data considered in terms of surface geology indicate a granitic layer underlying nearly all of southwestern Idaho. — HMB

Taylor, Beryl E. *See* Frick, Childs. 01782

01448 **Taylor, H. C. Jim.** Direct presentation of polished, petrographic thin sections to large groups: Geol. Soc. America Bull., v. 82, no. 5, p. 1405, 1971.

Polished thin sections, without cover glass, can be protected for display to an audience in a 35-mm slide projector by enclosing them in the 2 × 2 in. cardboard masks used for mounting 35-mm transparencies in glass slides. Cover glasses are unnecessary. The technique for viewing the section under polarized light is explained also. — VSN

01818 **Taylor, R. E.; Thomson, F. H.** Water for industry and agriculture in Washington County, Mississippi: Stoneville, Miss., Delta Council (prepared by U.S. Geol. Survey Water Resources Div. and Washington Co. Board of Supervisors), 64 p., illus., tables, 1971.

Surface and ground water in quantities capable of supporting large industrial, municipal, and agricultural developments are available in Washington County, Mississippi. Surface water is of satisfactory quality for nearly all agricultural uses and for many industrial uses. Extensive treatment would be necessary to make it acceptable for public water supplies. Five aquifers contain fresh water, whose base is more than 2,000 feet below sea level in a trough extending through Greenville southeastward. Southwest of Greenville the base is less than 600 feet below sea level. Ground water of good quality can be obtained throughout the county. Transmissibilities, specific capacities of wells and water quality are given for each aquifer. — *from* Authors' abstract

02081 **Taylor, S. R.; White, A. J. R.; Ewart, A.; Duncan A. R.** Nickel in high-alumina basalts — A reply [to discussion by C. E. Hedge of 1969 paper]: Geochim. et Cosmochim. Acta, v. 35, no. 5, p. 525-528, tables, 1971.

The abundance and significance of nickel in high-alumina basalts in island-arc environments is discussed in the light of comments by Hedge (ibid. p. 525-528, 1971). We conclude (1) that the low Ni and Mg contents of many high-alumina basalts preclude the possibility of deriving orogenic andesites from these rocks by fractional crystallisation; and (2) that the data are consistent with derivation of orogenic andesites by melting of the downgoing slab of oceanic crust in the island-arc tectonic environment. [For original paper *see* ibid. v. 33, p. 275-286, and p. 1555-1557 (Abs. North American Geology, July 1970), 1969.] — Authors' abstract

Taylor, Thomas N. *Telangiopsis See* Eggert, Donald A. 01564

Teichert, Curt. *See* Meyerhoff, A. A. 01677

01527 **Terasmae, J.** Notes on lacustrine manganese-iron concretions: Canada Geol. Survey Paper 70-69, 13 p., illus., 1971.

Manganese-iron concretions and other types of Mn-Fe precipitate have been found in many small lakes in Ontario and Nova Scotia and also in Lakes Michigan and Ontario. These deposits may contain up to 40 percent (by weight) of iron and 35 percent of manganese in addition to small amounts of other elements (Zn, Ni, Co, Pb, and Cu). The estimated abundance of these deposits indicates that they may have a mineral resource potental. The formation of the lacustrine Mn-Fe precipitates is not clearly understood, but appears to be related to geochemical processes through acid leaching in the watershed areas and transport by groundwater to sites of precipitation in lakes where higher pH levels and oxidizing conditions prevail. — Author's abstract

01739 **Texas Planning Agency Council.** (Water Oriented Data Programs Sec. Interagency Nat. Resources Council, compiler). Catalog of water oriented data (available from eight Texas state agencies) — V. 24, Bays and estuaries: [Austin, Texas] Texas Water Devel. Board, 69 p., illus., tables, 1971.

This catalog contains information about water data acquisition activities of various Texas State Agencies but not the actual water data. Information is catalogued by river basin (in this volume a basin number has been assigned to bays and estuaries), chapter, subject, county, the agency reporting the data and the agency reporting number. Data on ground water and waste disposal and some electric well logs are included. — EH

01431 **Theis, C. V.** Preliminary consideration of movement of ground water from infiltration areas on the Llano Estacado, Texas and New Mexico, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B236-B243, illus., 1971.

Theoretical models indicate that infiltration canals on the Llano Estacado would probably have to be 6 or 7 miles apart to provide all parts of their service area with water. Infiltration ponds or lakes, involving radial movement of water, would be closer — about 3 or 4 miles. These figures are based on equilibrium models assuming either constant hydraulic conductivity vertically and laterally or constant transmis-

sivity, assuming that the aquifer is isotropic. For the average hydrologic condition leading to values given above, a conductivity of 10,000 feet per yr or transmissivity equivalent to 30,000 gpd/ft in Meinzer units has been assumed. In areas where these estimates are exceeded, infiltration canals or ponds could be more widely spaced; where conductivity and transmissivity fall below these averages, infiltration structures would be closer together. — *from* Author's abstract

Theodore, Ted G. *See* Nash, J. Thomas. 01599

Thomas, Dorothy R. *See* Johnson, Stanley S. 02018

Thomas, J. A. *See* Huffman, Claude, Jr. 01422

01996 **Thompson, Alan Bruce.** Analcite-albite equilibria at low temperatures: Am. Jour. Sci., v. 271, no. 1, p. 79-92, illus., 1971.

The reaction analcite + quartz = albite + H_2O has been investigated in the range 130° to 250°C at 2 to 6 kb PH_2O, using a reaction-rate method involving weight change of quartz or albite crystals. Data suggest equilibrium at 190 ± 10°C at 2 kb, 170 ± 10°C at 4 kb, and 4.75 ± 0.5 kb at 150°C (PH_2O = Ptotal). The equilibrium curve has negative slope at higher pressures and intersects the slope for the reaction albite = jadeite + quartz in the region 50° to 120°C at PH_2O between 5 and 6.5 kb. The univariant relation between analcite and jadeite must have a positive slope. Single quartz crystal experiments on the reaction heulandite = laumontite + quartz + H_2O indicate equilibrium in the range 120° to 140° C at 2 kb PH_2O. These data are not satisfactory enough to bracket the equilibrium further. — *from* Author's abstract

01589 **Thompson, Geoffrey.** Spectroscopy in oceanography: Spex Speaker, v. 16, no. 2, p. 1-8, illus., tables, 1971.

Chemical oceanography, or the chemistry of sea water, marine organisms and marine sediments, is described. This paper is confined to inorganic aspects of these three constituents of the oceans, to the spectroscopic techniques used in analyzing them, and to the major and trace-elements found in each one. Products such as salt, bromine and magnesium are currently being recovered from sea water, a possibility of "farming" and "mining" marine organisms, which concentrate certain elements or trace elements in their bodies, exists, and manganese and phosphate are the elements most potentially recoverable from marine sediments. Methods of analyzing specimens, developed at Woods Hole Oceanographic Institution, are described. — EH

Thomsen, W. *See* Maxwell, R. A. 01583

Thomson, F. H. *See* Taylor, R. E. 01818

02039 **Threadgold, P.** Some problems and uncertainties in log interpretation, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. W1-W19, illus., 1971.

In critical cases where different measurements of nominally the same parameter (for instance, core and log derived porosities) do not agree, it is often very difficult to define the real reason for the discrepancy. Little work has been done on the quantitative assessment of possible errors in log derived values. Examination of possible errors involves (1) definition of what is actually measured by the various tools, (2) accuracy of the measurements, (3) relationship between the measurement and the desired information, and (4) validity of the model of the borehole and reservoir used in the evaluation. A critical reexamination of these points is necessary and should now be possible with modern equipment and techniques. — DBV

02079 **Threadgold, P.** Interpretation of thermal neutron die-away logs, some useful relationships, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. L1-L16, illus., 1971.

The paper initially discusses the use of thermal neutron capture cross section measurements as a porosity indicator. It describes how the logs may be used to check the consistency of other log derived parameters, and mentions the possibility of using capture cross section as an additional factor in helping to identify lithology changes. The major application of the measurement to assessing the magnitude of changes in relative fluid saturation with production is finally considered. — Author's abstract

Throop, William H. *See* Ratliff, J. R. 02034

08744 **Thurber, D. L.; Broecker, W. S.** The behavior of radiocarbon in the surface waters of the Great Basin, *in* Radiocarbon variations and absolute chronology — Nobel Symposium, 12th, Uppsala, 1969, Proc.: New York, John Wiley and Sons, and Stockholm, Almquist and Wiksell, p. 379-398, discussion, p. 398-400, illus., tables, 1970.

The mean exchange rates of CO_2 between the atmosphere and four lakes of the Great Basin of the western United States were measured using as tracers both natural radiocarbon and that produced by weapons-testing. The exchange rates for the lakes are within the range 4-10 moles per m^2 per year, corresponding to a range of transfer velocities for CO_2 of 250-600 m per yr, slightly less than, or equal to, those observed in the tropical Atlantic Ocean. Although the exchange rate for Mono Lake is comparable with that of the others, one would predict a higher rate than that observed for this lake because of its high CO_2 content. Slowness of exchange for this lake may be due to the presence of a natural layer of organic material on its surface which is sufficiently rigid to resist strong winds blowing across it and which inhibits gas exchange. This study may imply that although most waters are free of large-scale natural organic films, man-made pollution of water by oils or detergents may seriously affect the exchange rates of gases between the air and water. — *from* Authors' abstract

01450 **Tieh, Thomas T.; Cook, Earl.** Carbonate-rich dikes in ignimbrites of southeastern Nevada: Geol. Soc. America Bull., v. 82, no. 5, p. 1293-1303, illus., tables, 1971.

In southern Lincoln County carbonate-rich dikes intrude rhyolitic ignimbrites of the late Tertiary Kane Wash Formation. A cryptocrystalline calcite matrix — up to 55 percent of the rock — contains xenoliths of tuff and crustals and crystal fragments of quartz and sanidine. Minor constituents are iron-oxide granules, andradite crystals, basalt fragments, and small glass particles, many of which are tubular. This intrusive rock lacks the trace-element composition and petrologic associations of accepted carbonatites. C, O, and Sr isotope ratios are not diagnostic. The chemical composition, texture of the calcite, forms of the glass particles, and occurrence in ignimbrites that contain primary calcite indicate that the intrusive melt was formed by mixing of a silicate magma and melted limestone. — *from* Authors' abstract

01977 **Tien, Pei-Lin.** Ubiquity of hexahydrite in Kansas: Kansas Geol. Survey Bull. 202, pt. 1, p. 3-4, illus., 1971.

Field and laboratory observations indicate that the efflorescences of magnesium sulfate widely distributed in Kansas are hexahydrite ($MgSO_4 6H_2O$), not epsomite ($MgSO_4 7H_2O$). Epsomite occurs only as a transitional phase in the formation of hexahydrite. — Author's abstract

01857 **Tillman, R. W.** Petrology and paleoenvironments, Robinson Member, Minturn Formation (Desmoinesian), Eagle Basin, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 4, p. 593-620, illus., table, 1971.

During Des Moines times the Ancestoral Front Range to the east and the Ancestoral Uncompahgre highland to the southwest shed sediments into the Eagle Basin in Colorado. The Robinson Member is part of the 6,000-ft thick Minturn Formation deposited at this time. *Fuseline* biozones are present in the member and permit correlation of various parts of the member. Four distinctive facies are present in each of the limestone units of the member, and the pattern of distribution of these facies as well as sandstone beds provides data for basin configuration and the history of transgressive and regressive deposition. — SEF

02082 **Timur, A.; Hemphkins, W. B.; Massey, G. R.** Analysis of sidewall samples by nuclear magnetic resonance methods, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. T1-T21, illus., tables, 1971.

This paper describes a nondestructive and rapid technique for measuring porosity, permeability, and irreducible water saturation on irregularly shaped or small samples, using pulsed nuclear magnetic resonance (NMR). Laboratory experiments were conducted to obtain reliability estimates of NMR data, by continually halving the size of cylindrical core samples down to 1/4" × 1/4" fragments; there was no appreciable degradation of petrophysical parameter estimation due to decreased sample size. Field studies were made of sidewall samples accompanied by adjacent whole cores from sandstone reservoirs. The method was found to yield reasonable estimates of porosity, permeability, and irreducible water saturation from sidewall samples. — DBV

01462 **Tinkler, K. J.** Active valley meanders in south-central Texas and their wider implications: Geol. Soc. America Bull., v. 82, no. 7, p. 1783-1799, illus., tables, 1971.

Active valley meanders are those presently being incised in consolidated rock by abrasion and undercutting. They are analogous to widely known fossil incised meanders, and are distinguished from floodplain meanders. Formation of a floodplain may be independent of the hydrologic regimen of a basin and may cause loss in flow effectiveness rather than being the result of a real reduction in flow. Thus, effective (abrasional) flows in valley-meander situations may have recurrence intervals of 10-15 years. Assignment, as in the past, of recurrence intervals of 1-2 years for meander-shaping flows (as for bankfull flow in alluvial streams) may have led to overestimates of past discharges and climatic parameters in interpreting fossil incised meanders. — JHF

01776 **Toksöz, M. Nafi; Kehrer, Harold H.** Underground nuclear explosions – Tectonic utility and dangers: Science, v. 173, no. 3993, p. 230-233, illus., table, 1971.

The tectonic strain energy released by several underground nuclear explosions has been calculated through an analysis of seismic surface waves. The proportionally great amount of energy released in certain events suggests the possible uses for, as well as the hazards of, underground testing. — Authors' abstract

Tomlinson, K. W. *See* Price, W. A. 01952

01888 **Townley, John M.** El placer — A New Mexico mining boom before 1846: Jour. West, v. 10, no. 1, p. 102-115, illus., 1971.

Two decades before the discovery of gold in California in 1848, the placer deposits of the Ortiz Mts., 35 mi south of Santa Fe, in the Mexican Province of New Mexico, were being worked. The date of discovery is not known. The gold was quite coarse, mostly in scales or wires; gravels in which it occurs are 20 to 50 feet thick. Black sand was removed laterally, dried, winnowed, and then panned. Later, lode deposits were found in the upper canyons. During 1839, more placers were found on the northwest slopes of the San Pedro Mts. Gold was distributed more uniformly than in the Old Placers. The history of the state is interwoven with that of gold. — ESL

01540 **Tracy, Ronald W.** Gravity results obtained between Hawaii and California, aboard the R/V MAHI in 1969: Hawaii Inst. Geophysics Data Rept. no. 18 (HIG-71-3), 3 p., illus., tables, 1971.

Presented are profiles, listings, and charts of principal gravity facts and free-air and simple Bougher gravity anomalies obtained between Hawaii and California, aboard the R/V MAHI in 1969. — Author's abstract

01516 **Traverse, A.; Ames, H. T. (compilers).** Catalog of fossil spores and pollen — V. 33, Cretaceous pollen and spores: University Park, Pa., Pennsylvania State Univ. Palynol. Labs., 263 p., illus., 1971.

This volume contains, in its main body, descriptions of 25 new and 2 emended genera, 2 new subgenera, and 111 new species; these appeared in 7 publications, dated 1959 to 1965, on pollen and spores from the Cretaceous of Spain, Argentina (2), equatorial Africa, Hungary, Canada (Alberta), and Upper Cretaceous-Tertiary of Germany. Supplementary information not associated with original descriptions of new species is treated in appendixes, which include emended generic and specific descriptions, new combinations, and new names. From Singh's (1964) paper on microflora of the Lower Cretaceous Mannville Group, east-central Alberta, 23 new species of 17 pollen and spore genera (none new) are treated, and two genera, *Januasporites* (microspore) and *Equisetosporites* (ephedraceous pollen) are emended; other items from this paper are treated in the appendixes. — VMJ

01554 **Tremblay, Germain.** Sur les étapes successives de la mise en place du réseau hydrographique dans la région du Saguenay – Lac-Saint-Jean, Québec, Canada [Successive stages of the development of the hydrographic network in the Saguenay – Lac-Saint-Jean area, Quebec, Canada]: Cahiers Géographie Québec, v. 15, no. 34, p. 105-113, illus., 1971.

The geologic history of the Saguenay — Lac-Saint-Jean area north of Quebec includes deposition by the last Wisconsinan glaciation of a thick layer of unconsolidated sediments in two depressions in the Canadian Shield which were surrounded by highlands. Marine waters which invaded the area about 10,200 to 8,500 B.P. left a layer of marine deposits and clays. The author reviews ideas on the tectonic influences on the area. The pre-glacial courses of rivers are defined. The glaciers altered them considerably as shown on a map of the evolution of the drainage. — EH

01555 **Tremblay, Germain.** Conséquences géomorphologiques du relévement artificial du miveau du Lac-Saint-Jean [Geomorphological consequences of artificial raising of the level of Lac-Saint-Jean]: Cahiers Géographie Québec, v. 15, no. 34, p. 115-130, illus., tables, 1971.

This paper describes the changes in the shores of Lac-Saint-Jean, north of Quebec, due to natural changes in lake-level but especially to changes caused by building a dam at its outlet in the 1920's. Wave action has eroded shorelines and caused landslides, and flooding has caused damage to land and property. Erosion has been greatest where shores are of fine sand north of Pointe Bleue. Some stone embankments have been built to combat erosion but an overall plan is necessary to preserve beaches and property along the shore. — EH

01724 **Trenhaile, A. S.** Drumlins — Their distribution, orientation, and morphology: Canadian Geographer, v. 15, no. 2, p. 113-126, illus., tables, 1971.

An investigation of the drumlins of southern Ontario was conducted with the aim of quantifying certain aspects of drumlin occurrence. Drumlin distribution using four probability models appeared to be more regular than random, whereas orientation was characterized by normal distributions around a mean value. Ratios of 3.33:1, 44.4:1, and 13.3:1 were calculated for the length-width, length-height, and width-height relationships, with correlation coefficients of 0.65, 0.65, and 0.73, respectively. No clear relationship could be discerned between the lee and stoss slopes. Analysis of drumlin shape demonstrated the considerable variations in detailed form which occur. — Author's abstract

01816 **Trollman, W. M.; Maher, J. C.** Geological literature on the gulf and southeastern coastal regions of Alaska: Juneau, Alaska, Alaska Dept. Nat. Resources (in cooperation with the U.S. Geological Survey), 136 p., 1971.

This bibliography includes most geological literature, published before July 1, 1970, on the Gulf of Alaska and adjacent highlands, the southeastern panhandle of Alaska, and Kodiak Island. Oceanographic reports on the adjacent continental shelf are included. Emphasis was placed on the search for literature pertinent to petroleum geology and the closely associated fields of stratigraphy, paleontology, and geophysics, as well as on petroleum exploration and development and the geology of

mineral deposits. References are listed alphabetically by author and then indexed by subject. The compilation was prepared by the Alaska Branch of the U.S. Geological Survey in support of organic fuels investigations in Alaska. — EH

01858 **Truex, John N.** Directional survey problems, East Wilmington oil field, California: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 4, p. 621-628, 1971.

Even with the best directional surveys, control points in highly deviated wells in the East Wilmington oil field have vertical errors of ± 20 feet and vertical errors of ± 100 feet in 6,000-ft deep wells. In this situation the development geologist must eliminate or "average" suspect control points when constructing structure and isopach maps. — *from* Author's abstract

01882 **Tsai, Yi-Ben; Aki, Keiiti.** Amplitude spectra of surface waves from small earthquakes and underground nuclear explosions: Jour. Geophys. Research, v. 76, no. 17, p. 3940-3952, illus., tables, 1971.

Theoretical amplitude spectra of surface waves in a layered half-space are compared with the observed spectra for 13 underground nuclear explosions in the Nevada Test Site and for 12 earthquakes in the Gulf of California and in the United States. The amplitude spectral shape of Rayleigh waves for periods 10-50 sec from explosions does not vary much with the shot medium and the shot yield. Neither the source time function nor the finite source size appears to be the primary cause of the difference in spectral shape between underground nuclear explosions and small earthquakes. Rather, it is due to the small difference in focal depth and the different depth dependence of spectrum for different source mechanisms. Our result gives a theoretical basis for the use of amplitude spectra of Rayleigh waves at long periods as seismic discriminants between underground explosions and earthquakes. — Authors' abstract

01408 **Tschudy, Bernadine D.** Two new fossil pollen genera from upper Campanian (Cretaceous) rocks of Montana, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B53-B61, illus., table, 1971.

Two new fossil pollen species typifying two new genera [Siberiapollis; Montanapollis] were well represented in rock samples from the upper Campanian of Montana. These are similar to, and are probably relatives of, several pollen species previously described from Upper Cretaceous sediments from the Western Siberian lowland of the U.S.S.R. The new genera and species from Montana are described and illustrated, and five species from the U.S.S.R. are transferred from genus *Proteacidites* to one of the new genera. — Author's abstract

01994 **Tsuchiya, Yoshito.** Successive saltation of a sand grain by wind, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1417-1427, illus., table [1971].

In order to establish the mechanics of sand transport in an air or water stream, the mechanics of saltation of sand grains should be considered. In sand storms most saltating sand grains on a granular bed have successively continued the saltation motion. In this paper such a motion is defined as successive saltation. A theoretical approach to the saltation of a single sand grain on a fixed granular bed is proposed on the basis of equations of motion for the saltation and the dynamic characteristics of collision between a saltating sand grain and bed sand grains. Some experiments of successive saltation of a single sand grain on a fixed granular bed were carried out for comparison with theoretical relations. It was verified that theoretical relations of height and distance of saltation of a sand grain are in fairly good agreement with results of the experiment. — *from* Author's abstract

Tsui, Tien-Fung. *See* Li, Yuan-Hui. 01965

02064 **Turek, Andrew; Peterman, Zell E.** Advances in geochronology of the Rice Lake-Beresford Lake area, southeastern Manitoba: Canadian Jour. Earth Sci., v. 8, no. 5, p. 572-579, illus., table, 1971.

New Sr-87/Sr-86 data combined with previous work (1968) indicate three major events in the Rice Lake-Beresford Lake area. The oldest, 2,730 ± 50 m.y. ago, is interpreted as a period of regional metamorphism, granite emplacement, and gold-quartz mineralization post-dating the greenstones. A second period of metamorphism and granite emplacement 2,530 ± 40 m.y. ago affected the area as a whole, as evidenced by rejuvenated mineral ages. The youngest event, 2,345 ± 100 m.y., is recorded by the mylonites and may represent epeirogenic movement. — DBV

Turner, P. A. *See* **Brashear, H. R. 02001**

Turnock, A. C. *See* **Černý, P. 01894**

01966 **Tzur, Y.** Interstitial diffusion and advection of solute in accumulating sediments: Jour. Geophys. Research, v. 76, no. 18, p. 4208-4211, table, 1971.

A mathematical model for diffusion and advection in accumulating sediments is presented. The model's influence on material transport and concentration is discussed. It is concluded that previous authors were justified in using simpler models by neglecting the advective terms, but cases could arise in which these terms would be of importance. — Author's abstract

01795 **Uchupi, Elazar; Milliman, J. D.; Luyendyk, Bruce P.; Bowin, C. O.; Emery, K. O.** Structure and origin of southeastern Bahamas: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 5, p. 687-704, illus., table, 1971.

Geophysical data indicate the crust beneath the southeastern Bahamas is about 20 km thick, in part volcanic and including a carbonate apron about 10 km thick. This apron also covers the northwestern Bahamas, where the crust is about 30 km thick. The northwestern Bahamas may have formed first, over a sediment-filled intercratonic trough formed as continents separated. The southeastern Bahamas then formed an oceanic crust, over the fracture zone of a transform fault generated during continental rifting. The buried ridge beneath the Bahama Escarpment may express this fault. Oceanic origin, with the southeastern Bahamas built on oceanic crust, eliminates the problem of overlap onto Africa, in continental drift reconstructions. — BHK

Unger, W. L. *See* **Lineback, J. A. 01702**

Unterberger, R. R. *See* **Holser, W. T. 02037**

01729 **Urban, James B.** Palynology and the Independence Shale of Iowa: Bulls. Am. Paleontology, v. 60, no. 266, p. 103-189, illus., tables, 1971.

A diverse assemblage of palynomorphs has been recovered from a shale believed to be identical with the Independence Shale at Independence, Iowa; the present sample, from Brooks Quarry, Buchanan County, Iowa, was collected from a channel deposit of shale 2.5 feet thick and 6 feet wide, 15 feet above the base of the Middle Devonian Cedar Valley Limestone and completely surrounded by the limestone. The assemblage contains poorly preserved, obviously reworked, spores of Late Devonian age and better preserved Late Mississippian spores. The Independence Shale is interpreted as having been derived from the Upper Devonian Lime Creek Shale which was eroded and redeposited during Chester time as solution fillings in sinks and caves in Middle Devonian carbonate rocks. Eighty-one species (14 new, 4 new genera) of Late Mississippian spores are described and figured; the Devonian spores are identifiable only as to genus. — VMJ

01582 **U.S. Geological Survey.** (Water Resources Division). Water resources data for Maine, 1970 — Pt. 1, Surface-water records; Pt. 2, Water-quality records; Pt. 3, Ground-water records: Augusta, Maine, U.S. Geological Survey Water Resources Div., 114 p., tables, 1971.

Water resources data for 1970 in Maine given in this report include records of streamflow or reservoir storage at gaging stations and other sites, records of water-quality data on the chemical and physical characteristics of surface- and ground-water, and records of ground-water levels in index wells. — VSN

01956 **Vallianos, Limberios.** Recent history of erosion at Carolina Beach, N.C., *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1223-1242, illus., tables [1971].

Carolina Beach in southeastern North Carolina is experiencing inordinate and costly erosion due to an initially small, manmade interruption on the updrift barrier beach to connect the Atlantic Ocean and a lagoon. The channel, 8,000 feet north of the Carolina Beach town limits soon developed into a permanent coastal inlet. In the period 1952-1969, the inlet entrapped over 4 million cu yd of littoral material resulting in a concomitant downdrift erosion which progressed southward to the town. A protective beach fill placed along the town's oceanfront in 1965 has suffered considerable erosion. This paper develops and quantifies the cause and effect relations of the problem in terms of the alongshore processes and furnishes basic data on the performance of the artificial beach fill. — *from* Author's abstract

01409 **VanAlstine, Ralph E.** Amphibolites near Salida, Colorado, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B74-B81, illus., tables, 1971.

Field and chemical evidence is given for the origin of five Precambrian amphibolite samples from the Salida area, Colorado. It is concluded that concordant bodies of amphibolite were metagabbro sills at three of the localities and metabasalt flows at the other two. The chemistry and mineralogy of these two types of amphibolite are contrasted. The baggroic rocks have lower differentiation indices and higher crystallization indices than the basaltic rocks. The amphibolites follow trends of basic- or middle-stage differentiates and not those of sedimentary rocks. The plotted relationships of Ni, Cr, and Niggli ti ti Niggli mg for these amphibolites also are typical of basic igneous rocks. — Author's abstract

01962 **Vanders, Iris.** Color in minerals: Mineral Digest, v. 1, p. 50-59, ilus [1971?].

Color is one of the most striking properties of minerals, and the causes are varied and complex. Most important factors are: physical and psychological reactions of the eye and brain to wavelengths of light; type of incident illumination; presence of impurity ions and their interaction with neighboring ions; and type of atoms in the mineral, their geometric arrangement, and electrical forces or bonding between atoms. The play of colors in several minerals is described, and 9 color photographs are included. — ESL

vanDonk, Jan. *See* Bé, Allan W. H. 01688

01765 **VanLewen, M. C.; King, N. J.** Prospects for developing stock-water supplies from wells in northeastern Garfield County, Montana: U.S. Geol. Survey Water-Supply Paper 1999-F, 38 p., illus., tables, ground-water maps, 1971.

Ground-water resources in northeastern Garfield County, Montana, an area of grazing lands, afford a reliable source of stock water. Overlying the relatively thick and impermeable Bearpaw Shale are Fox Hills Sandstone and Hell Creek Formation, all of Cretaceous age, Tertiary Fort Union Formation, and thin glacial deposits and alluvium. All but the Bearpaw Shale and glacial deposits are potential aquifers. The upper part of the Fox Hills Sandstone, an aquifer 30-70 feet thick, crops out in the north and northwest parts of the area, and dips southeastward beneath younger beds. Wells in the north half of the area obtain water from this sandstone at depths of less than 200 feet. In the south part depth to water is up to 300 feet in Fox Hills Sandstone and in sandstone beds and lenses in Hell Creek and Fort Union Formations. Average depth to bedrock in the area is 195 feet. Underflow in alluvial deposits along stream valleys is a practical source of stock water. Water quality is generally poor. Chemical analyses are included. — *from* Authors' abstract

01644 **vanMoort, J. C.** A comparative study of the diagenetic alteration of clay minerals in Mesozoic shales from Papua, New Guinea, and in Tertiary shales from Louisiana, U.S.A. [with French, German, and Russian abstracts]: Clays and Clay Minerals, v. 19, no. 1, p. 1-20, illus., tables, 1971.

Gradual change in randomly interstratified montmorillonite-illite percentagein a section of Mesozoic shales at Barikewa, New Guinea reveal that depth of burial rather than stratigraphic level controls proportion of expandable material. Eocene shales in deep wells of Louisiana have similar diagenetic alterations in the Wilcox Formation. Amount of illite 2M polymorphs is less than 5 percent in Papuan samples, 43 percent in Louisiana samples; corresponding illite 10A peak sharpness ratios are about 1-4 and 2.0. MgO and K_2O values are lower in Papuan than Louisiana shales; the latter contain some chlorite, the former hardly any. Differences indicate more unweathered material in American samples; increase of chlorite and magnesium, and decrease of kaolinite from 12,368 feet down suggest a change in sedimentation pattern. — GDC

VanSchmus, W. R. *See* Banks, P. O. 01799

02046 **VanVoast, Wayne A.** Ground water for irrigation in the Brooten-Belgrade area, west-central Minnesota: U.S. Geol. Survey Water-Supply Paper 1899-E, 24 p., illus., tables, 1971.

Sufficient ground-water supplies of suitable quality for irrigation are available. Glacial drift, up to 300 feet thick, is underlain by Precambrian crystalline rocks; buried sand and gravel aquifers can be located by test drilling. Outwash comprises the upper part of the drift, is up to 100 feet thick, and made up of cross-bedded sand and gravel interbedded with silt. Transmissivity of this surficial aquifer ranges from less than 30,000 to 60,000 gpd per foot. Ground-water losses occur as base flow and underflow, and through evaporation; recharge is from precipitation. Water in buried and surficial aquifers is of the calcium magnesium bicarbonate type. An analog model showed effects on the surficial aquifer of withdrawals of about 20,000 acre-feet per sq mi per pumping season for 20 yr. Predicted water-level declines caused by withdrawal were generally less than five feet in the surficial aquifer. — *from* Author's abstract

01723 **Veber, V. V.; Gershanovich, D. Ye.; Sazonov, M. L.; Morozova, S. N.** Obrazovaniye gazoobraznykh uglevodorodov v sovremennykh shel'fovykh osadkakh tropicheskoy Atlantiki [The formation of gaseous hydrocarbons in modern shelf sediments of the tropical Atlantic]: Geologiya Nefti i Gaza, no. 6, p. 49-53, illus., tables, 1971.

Samples of bottom sediments from the Brazil-Guiana shelf area and the southern part of the Gulf of Mexico were studied and subjected to laboratory experiments. The results show that it is possible to generate gaseous hydrocarbons of heavy methane in modern marine sediments, both clay and sand, in both clastic and carbonate deposits. Up to a state of vacuum, hydrocarbons occur in connection with certain rock conditions and are separated out only after a sharp decrease in pressure. The escape of gas and formation of fissures in sediments contribute to decreased downward compression in strata, which in turn leads to an elevation of the strata. — EH

01529 **Vedder, James F.** Microcraters in glass and minerals: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 291-296, illus., table, 1971.

The morphology of craters formed in glass, oligoclase, and olivine by micron-size projectiles with velocities up to 14 kmps changes with the velocity and angle of incidence of the projectile. An energy-dispersive X-ray analysis of the crater provides information about the projectile composition in some cases. These results are an aid in the interpretation of microcraters observed on lunar samples. — Author's abstract

Vedder, James F. *See* Mandeville, J.-C. 01530

Vedder, John G. *See* Szabo, Barney J. 01602

Veigele, William J. *See* Bracewell, Bobby L. 01517

01719 **Venkatachala, B. S.; Salujha, S. K.** Pollen and spores from the pre-Verne cyclical formation of the Saginaw Group, Grand Ledge, Michigan, U.S.A.: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 17, p. 263-281, illus., 1971.

Dispersed spores belonging to 36 genera (mostly organ-genera) and 63 species (9 new) were recovered from shale samples collected below Cycle "A" of the pre-Verne cyclical formations of the Early Pennsylvanian Saginaw Group at Grand Ledge, Mich. All of the major plant groups known to have inhabited the coal swamps are represented by the spores and pollen (Lycopsida, Sphenopsida, Pteropsida, Cycadofilicales, Cordaitales or ,Coniferales). They are arranged according to the morphological classification system for Sporae dispersae suggested by Bharadwaj and Venkatachala (1968). — *from* Authors' abstract

08755 **Vilks, G.; Anthony, E. H.; Williams, W. T.** Application of association-analysis to distribution studies of Recent foraminifera: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1462-1469, illus., tables, 1970.

Counts of species of foraminifera from 75 samples of sediment from East Bay, MacKenzie King Island, in the Canadian Arctic were converted to a matrix of presence-absence data (56 species × 75 stations). These were submitted to both normal and inverse association-analysis as a preliminary test of the application of that multivariate method to problems in marine ecology. The results are compared with observations made at the time the survey was carried out. Although the pattern of sampling was not the most suitable for association-analysis, the results indicate that the method may prove quite informative. — Authors' abstract

01457 **Visher, Glenn S.** Depositional processes and the Navajo Sandstone: Geol. Soc. America Bull., v. 82, no. 5, p. 1421-1423, illus., 1971.

Comparison of a vertical sequence of sedimentary and biogenic structures, grain size distributions, and lithologies suggests a similarity between the Altamaha River Estuary, Ga., and an outcrop of the Navajo Sandstone near Woodside, Utah. Direct comparison between a Holocene environment and the characteristics of the ancient sandstone unit provided the basis for the suggested environmental interpretation. — Author's abstract

01847 **Viswanathan, S.; Perry, E. C., Jr.; Sims, P. K.** Oxygen isotopic studies of Early Precambrian granitic and metamorphic rocks from the western part of the Giants Range batholith, northwestern Minnesota [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 66-69, table, 1971.

01664 **Voegele, M.; Hudson, J. A.** Photographing polished rock specimens: Minnesota Univ. Mineral Resources Research Center Progress Rept., no. 24, p. 130-137, illus., 1971.

A significant part of the experimental data in laboratory studies of rock failure is the appearance of the specimen at the conclusion of the experiment. Photographic techniques are described in this paper which will help to produce photographs with the required characteristics. The authors recommend that laboratory personnel photograph specimens themselves thus saving time, expense and the distress usually associated with commercial photographs. — Authors' abstract

01848 **Vogel, T. A.; Rohrbacher, T. J.** Chemically zoned native copper and chalcocite from White Pine, Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 70, 1971.

VonGenton, W. D. *See* McCall, Charles. 02027

Vreeland, John H. *See* Bonini, William E. 01937

01427 **Waldrop, H. A.** Thermal infrared detection of glacial gravel, Yellowstone National Park, Wyoming, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B202-B206, illus., table, 1971.

Well-drained glacial gravel in Yellowstone National Park can be distinguished from bedrock and till by its darker tone on evening thermal infrared imagery. Well-drained gravel supports relatively thin forest, which cools more rapidly at night and shows a

darker infrared tone than thicker forest on different materials. Other conditions that produce dark infrared tone must be considered, but in the report area the dark-tone anomaly is a useful reconnaissance aid in outlining probable deposits of glacial gravel. Hydrothermal activity registers directly on thermal infrared imagery; other geologic features in Yellowstone National Park register indirectly by their topographic expression, which is more evident on radar imagery and vertical aerial photographs. — Author's abstract

Waldstein, Peter. *See* Makovsky, Leo E. 01685

01442 **Walker, Roger G.** Nondeltaic depositional environments in the Catskill clastic wedge (Upper Devonian) of central Pennsylvania: Geol. Soc. America Bull., v. 82, no. 5, p. 1305-1326, illus., tables, 1971.

The Catskill clastic wedge consists of turbidites, slope deposits, alternating shallow marine and nonmarine sediments, and alluvial plain fining-upward sequences. The section varies from east to west: distal turbidites are continuous, proximal are only in the east (Lehigh Valley area); slope deposits of shale thin easterly from 60 to 3 m; intercalated marine and nonmarine beds of short facies sequence are only in the west (Susquehanna Valley area); alluvial plain deposits are continuous. The clastic wedge grew over the proximal turbidites with the permanent establishment of an alluvial plain. The result is more comparable to the quiet prograded muddy coast of western Louisiana than to the commonly inferred sandy delta. — RGY

Walter, Louis S. *See* Nava, David F. 01754

Walther, C. *See* Haupt, W. 08728

08768 **Walton, Brian J.; Arnold, Allan R.** Plutonic nodules in lamprophyric carbonatite dykes near Frederikshab, South-West Greenland: Medd. Grönland, v. 190, no. 5, p. 26, illus., tables, 1970; Grönlands Geol. Undersögelse Bull. 91, 1970.

A swarm of thin NW-SE lamprophyric carbonatite dikes of Mesozoic age, south of Frederikshaab, occurs with a contemporaneous, parallel swarm of thick dolerites. Besides local country rock, inclusions in the carbonatites are: single crystals of olivine probably derived from the upper mantle; unmodified garnet- and pyroxene-granulite nodules from a lower level; nodules and single crystals, mainly of hornblende and salitic pyroxene, considered formed by reaction between carbonatite magma and acid to intermediate lower crustal rocks at low levels in dikes; alkaline nodules, similarly metasomatic but developed at possibly higher levels; and phlogopite megacrysts, maybe partly xenocrystal, but thought to have crystallized mainly from contaminated magma. Complete chemical analyses of lamprophyric carbonatites and partial analyses of individual minerals are presented. — *from* Authors' abstract

08771 **Waltz, James P.** Water transfer at bedrock-alluvium contacts, *in* Ogallala Aquifer Symposium, Lubbock, Texas, 1970 [Proc.]: Lubbock, Tex., Texas Tech. Univ. Special Report No. 39, Internat. Center for Arid and Semi-Arid Land Studies, p. 145-153, illus., 1970.

The Colorado Ground Water Management Act of 1965 provides for the establishment of "Designated" Ground Water Basins in the state so that equitable water management polices can be formulated within each basin. Fundamental to the concept is the isolation of water — that is, a minimum of surface and(or) ground water should flow from one basin to another. Three of the six designated basins have geologic and hydraulic characteristics which may partially invalidate the purpose of the Act; appreciable volumes of water may be passing through the contact between the alluvial aquifers and the supposedly impermeable bedrock in the High Plains, Kiowa-Bijou, and Black Squirrel designated basins. This paper briefly describes the characteristics of these basins, the nature of investigations in them, and evidence of ground-water transfer, and comments on the implications of such ground-water transfer. — DBV

01775 **Ward, Peter J.; Jacob, Klaus H.** Microearthquakes in the Ahuachapan geothermal field, El Salvador, Central America: Science, v. 173, no. 3994, p. 328-330, illus., 1971.

Microearthquakes occur on a steeply dipping plane interpreted here as the fault that allows hot water to circulate the surface in the geothermal region. These small earthquakes are common in many geothermal areas and may occur because of the physical or chemical effect of fluids and fluid pressure. — Authors' abstract

Wartburg, A. F. *See* Cadle, R. D. 02053

01638 **Wasson, John.** Differentiated meteorites, *in* Planetology, U.S. National Report, 1967-71, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 7, p. IUGG 441-447, 1971.

This is a review and bibliography of work on meteorites not commonly classified as chondrites, published by American authors in 1967-70. The discussion is arranged according to meteorite class: achondrites, stony irons, and irons; general studies are also cited. The bibliography is four and one-half pages long. — DBV

01608 **Wasson, John T.** Volatile elements on the earth and the moon: Earth and Planetary Sci. Letters, v. 11, no. 3, p. 219-225, illus., table, 1971.

Comparison of concentrations of volatile elements in terrestrial and lunar rocks shows that elements with the highest terrestrial lunar concentration ratios are the same ones showing high abundance in C1 chondrites relative to ordinary chondrites. The terrestrial/lunar concentration ratio pattern is inconsistent with partial volatization or condensation processes, but in agreement with accretion of a volatile-rich component to the Earth in amounts greatly exceeding those accreted to the Moon. It is proposed that the bulk of the Earth and Moon formed from materials having low contents of volatile elements, and that volatiles were added during a final stage in which the main source of accreted matter was comets. If the Earth had an atmosphere at this time, it would have retained nearly all of the accreting material, whereas an atmosphereless Moon may have retained as little as 0.003 of it. — *from* Author's abstract

Watanabe, Akira. *See* Horikawa, Kiyoshi. 01942

02011 **Water Well Journal.** Geophysics and ground water — A primer — Pt. 1, An introduction to ground-water geophysics: Water Well Jour., v. 25, no. 7, p. 43-60, illus., 1971.

This article, the first of a two-part series, presents the basic principles and practical aspects of ground-water geophysics and is designed to assist water-well contractors and state and municipal agencies in ground-water exploration and development. It describes each of the surface and borehole geophysical techniques and its application to ground-water exploration. — EH

01743 **Watkins, N. D.; Richardson, A.** Intrusives, extrusives and linear magnetic anomalies: Royal Astron. Soc. Geophys. Jour., v. 23, no. 1, p. 1-13, illus., 1971.

The definition of narrow linear oceanic magnetic anomalies resulting from dikes and associated extrusive bodies is compared to anomalies resulting from dikes without extrusives. It is shown that if the extrusive has a tapering cross-section with maximum thickness over the center of extrusion, then peaks of the resulting linear magnetic anomalies will possess a sharper definition than the anomalies due to a dike alone, provided the horizontal extent of the extrusive is of the order of, or less than, the depth of the ocean. Geomagnetic polarity events recorded by dike injection into a spreading oceanic crust will therefore not necessarily become "smeared" by the presence of substantial associated extrusive phases. — Authors' summary

01470 **Watkins, Norman D.; Gunn, Bernard M.; Baksi, Ajoy K.; York, Derek; Ade-Hall, James.** Paleomagnetism, geochemistry, and potassium-argon ages of the Rio Grande

de Santiago Volcanics, central Mexico: Geol. Soc. America Bull., v. 82, no. 7, p. 1955-1968, illus., tables, 1971.

Seventy-two oriented cores of 2.5 cm diameter have been drilled from seven bodies comprising part of a sequence of ignimbrite sheets interdigitated with basalts and basaltic andesites, in the Grand Canyon of the Rio Grande de Santiago of the Mexican Cordilleran Volcanic Province. Field observations and whole-rock analyses reveal two groups: an olivine basalt-high alumina basalt-basaltic andesite series, and a sequence of rhyolitic ignimbrite sheets, with some rhyolitic and obsidian lava flows. The paleomagnetic polarity sequence with decreasing age is R, R, N, R, R, N, N, providing easily measurable markers of high potential stratigraphic value. K-Ar analyses show two volcanic episodes at 4.6 to 5.5 m.y. and 8.7 to 9.5 m.y. — *from* Authors' abstract

Wawersik, W. R. *See* Starfield, A. M. 01658

01934 **Wayland, T. E.** Geologic occurrence and evaluation of bentonite deposits: Soc. Mining Engineers AIME Trans., v. 250, no. 2, p. 120-132, illus., tables, 1971.

The general geology and mineralogy of bentonite, including pertinent technological details of clay minerals in the montmorillonite group, are summarized. Worldwide occurrences of bentonite deposits are reviewed, with emphasis on geologic methods and economic principles of evaluation. Active mining districts are described, and areas with potential for current and future development are assessed. The production history of bentonite, principal producers, major consumers, and indicated trends are noted; also attention is directed to the hundreds of minor industrial uses of this versatile material, ranging from the manufacture of (A)cid to (Z)eolite water softeners. Recent significant results of both basic and applied research are reported, with suggested lines of investigation for current and near-future consideration. — Author's abstract

Webb, Harry W. *See* Bartlett, Charles S., Jr. 02013

01821 **Webb, William M.; Potter, Paul E.** Petrology and geochemistry of modern detritus derived from a rhyolitic terrain, western Chihuahua, Mexico: Soc. Geol. Mexicana Bol., v. 32, no. 1 (1969), p. 45-61, illus., tables, 1971.

First cycle sands in streams draining a small portion of the Sierra Madre Occidental of western Chihuahua were studied petrographically and chemically. Detritus derived from this semi-arid, mountainous terrain, one underlain almost completely by rhyolitic tuff, is unweathered and forms a strikingly immature lithic arenite. Rhyolitic rock fragments range between 45 and 69 percent of the framework fraction. This detritus is petrographically compared with 18 other volcaniclastic sands of erosional origin from the circumpacific region and its composition in future sedimentary cycles is speculated. — Authors' abstract

Webster, A. H. *See* Nickel, E. H. 01895

01574 **Weertman, J.** Allen-Wallace zone of the San Andreas fault and discontinuous yielding of a slip band in a crystal: Nature Phys. Sci., v. 231, no. 18, p. 9-10, illus., 1971.

Weertman (1967) has suggested that a model derived for the discontinuous yielding of a slip band in a crystal could be applied to earthquake occurrence. This article applies the model to a segment of the San Andreas fault. It is predicted that the next great earthquake on that fault will lie within one of the active zones pointed out by C. R. Allen (1968), either between Los Gatos and Bitterwater Valley or between Parkfield and Cholame. It would most likely occur when total creep slippage in the area between Parkfield and Bitterwater Valley is about equal to slippage in the 1906 and 1857 earthquakes (about 6 m). If average rate of slippage in the past is similar to the present rate (5 cm per yr), a great shock could be nucleated in about 55 years if creep slippage began after 1906 and in about 6 years if it began after 1857. — DBV

01680 **Weertman, J.** Shear stress at the base of a rigidly rotating cirque glacier [with French and German abstracts]: Jour. Glaciology, v. 10, no. 58, p. 31-37, illus., table, 1971.

The value of the basal shear stress is derived for two-dimensional and three-dimensional cirque glaciers. It is assumed that a cirque glacier moves primarily by a rigid-body rotation over a bed of cylindrical or spherical shape. In the region of maximum ice thickness the new value of the basal shear stress is only about one half that derived from equations in common use in the literature. The new expression for the basal shear stress of a cirque glacier is used to correct a data point in Paterson's recent compilation of measured sliding velocities and basal shear stresses of glaciers [1970]. — Author's abstract

Welblen, P. W. *See* Mudrey, M. G., Jr. 01839

01853 **Welblen, Paul W.; Morey, G. B.; Mudrey, M. G.** Guide to the Precambrian rocks of northwestern Cook County as exposed along the Gunflint Trail, *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 97-127, illus., 1971.

Besides four pages of road log for Trip B, including short descriptions at stops, the paper presents a comprehensive summary of recent work in the area, including descriptive stratigraphy and structure of the Precambrian in Cook County. Phases of the Saganaga Granite, and metamorphic zones in the Animikie Group are included. Detailed rock descriptions, given by Nathan (1969) to his layered series in the Upper Precambrian are summarized here. Titanium and copper-nickel mineralization have possibilities. — ESL

02015 **Weir, J. E., Jr.** Hydraulic testing of the Ojo Alamo sandstone in hole GB-3, Project Gasbuggy, Rio Arriba County, New Mexico — Gasbuggy 5: Springfield, Va., Natl. Tech. Info Serv. (U.S. Geol. Survey 474-91), 26 p., illus., tables, 1971.

Hydraulic tests were made August 24 to September 2, 1969, in the Ojo Alamo Sandstone of Cretaceous age in hole GB-3, drilled 20 months after the Gasbuggy nuclear explosion. The tests were made to determine whether increases in fracture permeability occurred as a result of the Gasbuggy experiment to stimulate gas production from a low yield reservoir. The lower part of the formation, 3,564 to 3,686 feet below ground level, had a transmissivity of 1.56 gpd per ft. Comparing this value with that for T (2.64 gpd per ft), determined before the explosion for virtually the same stratigraphic interval in hole GB-1 in February 1967, suggests that the Gasbuggy experiment fractured none of the lower Ojo Alamo at hole GB-3 or that fracturing was insufficient to manifest itself through a permeability increase. A water sample from hole GB-3 shows a slight increase in radioactivity. — *from* Author's abstract

Wells, D. M. *See* Claborn, B. J. 08710

01957 **Wells, Donald R.; Sorenson, Robert M.** Scour around a circular cylinder due to wave motion, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1263-1280, illus., tables [1971].

A vertical circular cylinder to simulate a pile and a built-up section containing a horizontal bed of fine sand were installed in a two-dimensional wave tank and subjected to monochromatic waves of differing characteristics. Conditions for incipient motion were observed for three sands. The magnitude and pattern of ultimate scour and the time interval required to reach this state were measured for six conditions of wave steepness and relative depth. Results were related to influential parameters including wave, pile and sediment characteristics and developed by dimensional analysis. Conclusions regarding critical flow velocity for incipient motion, effect of the parameters on incipient motion and ultimate scour depth, time required for maximum scour, significance of eddies generated by the pile, and catalytic action of the pile in causing the initiation of scour are presented. — *from* Authors' abstract

Wells, John W. *See* Stehli, Francis G. 01493

01926 **Wengerd, Sherman A.** Chronostratigraphic analysis and the time surface (with Spanish and English abs.): Soc. Geol. Mexicana Bol., v. 32, no. 1 (1969), p. 1-13, illus., 1971.

Classical stratigraphy involves logical subdivisions of strata based on lithology, fossils, and unconformities. As subdivision is prerequisite to correlation, and correlation infers time equivalence of stratal units, the stratigrapher must recognize criteria, establish parameters, and correlate characteristics over wide areas to understand the tectonic history of a basin of sediment deposition. Recognition of chronostratigraphic events recorded on lithologic logs of outcrops, on sections, and by detailed lithologic descriptions of well samples, plus use of detailed geophysical well logs, suggests that stratigraphic sections have inherent markers which are essentially isochronous and highly reliable for intrabasin correlation and delineation of porosity zones that control migration and accumulation of petroleum. — *from* Author's abstract

West, G. F. *See* Halls, H. C. 01822

West, G. F. *See* Halls, H. C. 01823

02028 **Westbrook, L. Paul; Lee, W. John.** Average water saturation from capillary pressure data, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. F1-F12, illus., table, 1971.

This paper proposes a method for estimating average water saturation in stratified reservoirs. The method requires capillary pressure data and an estimate of average permeability in the reservoir. In the past, there has been some question as to how this average permeability should be determined. Therefore computer studies, using field capillary pressure data, were performed on hypothetical stratified reservoirs to determine a satisfactory method of estimating average permeability to determine average water saturation. Use of geometric average permeability proved to yield reliable average water saturation estimates; use of arithmetic average permeability frequently led to unacceptably large errors. — Authors' abstract

White, A. J. R. *See* Taylor, S. R. 02081

01849 **White, W. S.; Hubbard, H. A.; Brooks, E. R.; Johnson, Robert F.; Wilband, J. T.** Keweenawan stratigraphy of westernmost Michigan [abs.], *in* Institute on Lake Superior Geology, 17th Ann., Duluth, Minn., May 1971: Duluth, Minn., Univ. Minnesota, p. 71-72, 1971.

01557 **Whittemore, R. E.** (editor). NSS-71 guidebook: Region Rec., v. 1, no. 4, 141 p., illus., 1971.

This number of The Region Record, published quarterly by the Virginia Region of the National Speleological Society, is devoted to a guidebook for the NSS National Convention held at Blacksburg, Va. Locations, descriptions, and maps of 34 caves within a two-hour drive are included, along with three guides to convention field trips: karstlands excursion to southwestern Virginia; biological tour of Greenbrier Caverns; and a local Appalachian geology field trip. Two papers are cited separately. — ESL

Whittemore, Robert E. *See* Holsinger, John R. 01558

02029 **Wichmann, P. A.** Neutron activation for elemental determination in boreholes, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. G1-G18, illus., 1971.

This paper reviews some of the neutron activation logging methods used in the past few years. They depend almost entirely on the half lives and radiation intensity of the activation products. The elements most conveniently identified are O, Si, and Al. Field examples of the logs and (or) measurements involved in each of these determinations are given. The application and relative value of each of these determinations, limitations of present field techniques, and possible solutions of the limiting

problems (most likely solution, gamma spectral measurements to define activation products) are discussed. Field examples are given to support the validity of these solutions. The method is a viable approach for determining lithologic components in boreholes containing a wide range of conditions. — DBV

Wichmann, P. A. *See* Guyod, Hubert. 02041

Wiese, Allen F. *See* Schneider, Arland D. 08717

Wiesnet, Donald R. *See* Stiles, Newell T. 01940

Wignall, T. K. *See* DeGeoffroy, J. 01498

Wilband, J. T. *See* White, W. S. 01849

01874 **Wilcox, J. T.** Preliminary investigations of heavy minerals in the McNairy Sand of West Tennessee: Tennessee Div. Geology Rept. Inv. 31, 11 p., illus., tables, 1971.

The total heavy-mineral content of 17 sand samples from seven localities in West Tennessee ranges from 0.4 to 17.2 weight percent. An additional sample of recently reworked sand contains nearly 30 percent heavy minerals. The mineralogy and size distribution characteristics of six samples with more than 6 percent heavy minerals were examined in detail. The 100-mesh (149-micron) to 150-mesh (105-micron) seive fraction contains more than 50 percent of the entire sample in four of the six highest grade sands. Most of the heavy-mineral content is in the minus-170-mesh (88-micron) fraction. In one sample, removal of the plus-150-mesh (105-micron) and minus-400-mesh (37-micron) fractions yields a concentrate that contains 45 percent heavy minerals. The major heavy minerals present in approximate order of decreasing abundance are ilmenite, leucoxene, staurolite, kyanite, zircon, rutile, monazite, and tourmaline. X-ray diffraction and polished surface data indicate that variations in the magnetic susceptibility of ilmenite are explained partly by differences in extent of weathering and partly by the presence of exsolved magnetite inclusions. — Author's abstract

01993 **Wilde, P.; Yancey, T.** Sediment distribution and its relations to circulation patterns in Bolinas Bay, California, *in* Coastal engineering — V. 2, Coastal Eng. Conf., 12th, Washington, D.C., 1970, Proc.: New York, Am. Soc. Civil Engineers, p. 1397-1415, illus., table [1971].

Grain size and heavy mineral analyses of marine sediment and rocks from Bolinas Bay are part of a long-term sediment transport study. Sediments in the bay are predominantly very fine sands, but adjacent to Duxbury Reef have a coarse sand to pebble component. Heavy minerals are predominantly green hornblende with some hypersthene and augite, with high concentrations of glaucophane and jadeite locally near shore. A tongue of high concentrations of minerals with a granitic source extends northwest from the San Francisco Bar, which is the major source of heavy minerals, flanked on the north and northeast by increasing landward concentrations of Franciscan metamorphic minerals. The circulation of the bay is primarily counterclockwise. Tidal influence of Bolinas Lagoon is restricted to about one mile from its mouth. Annual sediment flux in Bolinas Bay is about 300,000 cu yd. Bottom sediments are apparently in quasiequilibrium. — *from* Authors' abstract

Wilding, L. P. *See* Everett, K. R. 01455

William, Fred G. *See* Ratliff, J. R. 02034

Williams, R. S., Jr. *See* Oldale, R. N. 01413

01714 **Williams, Richard J.** Reaction constants in the system Fe-MgO-SiO_2-O_2 at 1 atm between 900° and 1300°C — Experimental results: Am. Jour. Sci., v. 270, no. 2, p. 334-360, illus., tables, 1971.

Reversed data on the compositions of coexisting solids and measured values of oxygen fugacity have been used to calculate the equilibrium constants for five reactions. The constants have been combined with data from Wones and Gilbert (1969) for the reaction $2\ Fe_3O_4 + 3\ SiO_2 = 6\ FeSi_{0.5}O_3 + O_2$ to derive the equilibrium constants for all possible stable and metastable reactions in the system Fe-MgO-SiO_2-O_2, except those involving hematite. The distribution constant, log K_D, has a small temperature dependence, and thus it is not useful as an accurate geothermometer. The reaction $Fe_3O_4 + 3\ FeSiO_3 = 6\ FeSi_{0.5}O_3 + 1/2\ O_2$ is useful as a geothermometer and oxygen geobarometer when combined with data on the magnetite-ulvöspinel tie lines. — *from* Author's abstract

Williams, W. T. *See* Vilks, G. 08755

01521 **Willman, H. B.** Summary of the geology of the Chicago area: Illinois Geol. Survey Circ. 460, 77 p., illus., geol. map, 1971.

The general geology of northeastern Illinois is important in regional planning. Glacial units shown on the map were deposited by the Lake Michigan Lobe of the Wisconsinan glacier which built at least 19 moraines during a pulsing retreat. Materials deposited, besides the tills, include sand and gravel deposited by streams flowing from the glacier, by discharge from glacial lakes, and accumulations in lakes dammed by glaciers. After the ice retreated, lacustrine deposits accumulated in Lake Chicago, the wind blew sand into dunes, and deposited a thin layer of silt on uplands. The map also shows where Ordovician to Silurian, and Pennsylvanian formations crop out. Major structural features are the Kankakee arch, Sandwich fault zone, and Des Plaines disturbance. Mineral resources are dolomite and limestone, sand and gravel, clay and shale, and coal. — *from* Author's abstract

Wilson, Allan C. *See* Gorman, George C. 01593

Wilson, F. *See* Maxwell, R. A. 01583

01691 **Wilson, L. G.** Observations on water content changes in stratified sediments during pit recharge: Ground Water, v. 9, no. 3, p. 29-40, illus., 1971.

Two pit recharge tests were conducted near Tucson, Arizona, using cooling tower blowdown effluent from a nearby power plant. The first trial consisted of continuous inundation for 142 days, the second of 15 wet-dry cycles with total innundation time of 80 days. From changes in water content profiles and piezometer data, it is speculated that three main stages prevailed in the history of the two flow regimes: development, equilibrium, and drainage. Cyclic recharging was more effective; almost as much water was recharged in the 80 days of the second test as in the 142 days of the first. The zone of aeration constituted a substantial reservoir for in-transit storage of recharged water. — DBV

01586 **Wing, Russell T.** The discovery of the wingstars: Minneapolis, Minn., T. S. Denison and Company, 43 p., illus., 1971.

In the author's collection of stones of many kinds, started in Minnesota in 1900, one "jewel" had long been a puzzle. Identified as quartz, it was examined for signs of fusion that might prove it a meteorite; there was no crust, but a transparent glaze, barely detected by staining in fine seams, covers a freckled surface of fusion froth over tiny pits. Picked up from glacial, gravel, and other deposits, deserts, and glaciated soils, many other stones in the collection show similar and more convincing evidence that they had been orbited from Earth and back again as meteorites coated in space. Listed with plates are 200 "wingstars," of petrified wood, fossilized, or faceted ancient sedimentary rocks that orbited perhaps 5 m.y. ago, then re-entered Earth's atmosphere; some have glaciated or spaciated scratches under the glaze. — GDC

02010 **Wobber, Frank J.** Apollo-9 multiband imagery of southern Arizona: World Mining, v. 24, no. 5, p. 36, illus., 1971.

Spectral bands A, B, C, and D photographs taken by Apollo-9 about 130 nautical miles above the California-Arizona border east of the Colorado River are reproduced and interpreted. Small-scale multiband photographs prove to be better than broad-band color imagery when viewed monoscopically. Multiband imagery is often superior for geological analysis when the interpreter must depend on textural variations for lithological discrimination. — EH

01624 **Wodzicki, Antoni.** Migration of trace elements during contact metamorphism in the Santa Rosa Range, Nevada, and its bearing on the origin of ore deposits associated with granitic intrusions [with German abstract]: Mineralium Deposita, v. 6, no. 1, p. 49-64, illus., tables, 1971.

Eighty-two samples from eight granodiorite stocks and adjacent metasedimentary rocks were analyzed spectrochemically for B, Li, Sn, Pb, Cu, Zn, Ni, Mn, Cr, V, and Ti, to detect changes in element distribution during hornblende hornfels facies metamorphism. Results show that B, Li, Sn, Pb and in some instances Cu and Zn diffused from the country rocks into the magmas, suggesting that such a process may enhance the potential of a magma as a source of epigenetic ore deposits. — Author's abstract

Wolfe, C. Wroe. *See* Lyons, Paul C. 01512

01406 **Wolfe, Jack A.; Pakiser, Helen M.** Stratigraphic interpretations of some Cretaceous microfossil floras of the Middle Atlantic States, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B35-B47, illus., table, 1971.

Palynologic analysis of surface samples from the Patuxent, Patapsco, Raritan, and Magothy Formations indicates that these units can be divided into two major sequences separated by a major hiatus. The lower sequence includes the Potomac Group (Patuxent, Arundel, and Patapsco Formations) of Maryland and Virginia, and the Raritan Formation of northern New Jersey. The Potomac Group ranges in age from probable late Aptian or early Albian through earliest Cenomanian, and the Raritan Formation is entirely of Cenomanian age. The upper sequence — the Magothy Formation — is of Santonian and earliest Campanian age. The Amboy stoneware clay, formerly included in Raritan, has a rich flora allied to that of the Morgan and Cliffwood beds of the Magothy and was recently reassigned as the basal unit of the Magothy. Old Bridge Sand Member is herein removed from the Raritan and made the basal member of the Magothy. — *from* Authors' abstract

01584 **Wolfe, W. R.** Golden Anniversary, 1921-1971 — The reflection seismograph: Shale Shaker, v. 21, no. 7, p. 162-163, illus., 1971.

This article gives the history of the reflection seismograph from 1921 to 1971 and short sketches of the careers of the four pioneers who developed it. — EH

Wollenberg, Harold. *See* Lövborg, Leif. 01501

02088 **Wollin, G.; Ericson, D. B.; Ewing, M.** Late Pleistocene climates recorded in Atlantic and Pacific deep-sea sediments, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 199-214, illus., table, 1971.

Good agreement was found among three planktonic foraminiferal indicators in deep-sea sediment cores for interpreting climates. In cores from the Atlantic about twenty climatic oscillations with periods of about 550 years are superimposed on the long-period trend of postglacial time. The climatic records in Atlantic and Caribbean cores indicate that there were maximums of warm conditions about 25,000, 40,000, and 65,000 years ago during the Wisconsin glacial stage. Comparison of the Pleistocene climatic records of the last million years in cores from the Pacific with similar records in cores from the Atlantic suggests that times of warm surface water in some regions of the Pacific were partly synchronous with times of cool water in the Atlantic. — *from* Authors' summary

02007 **Wright, H. E., Jr.** Late Quaternary vegetational history of North America, *in* The Late Cenozoic Glacial Ages (Karl K. Turekian, editor): New Haven, Conn., and London, Yale University Press, p. 425-464, illus., 1971.

Central questions for recent pollen studies have been: To what extent was vegetation of unglaciated areas affected by climatic changes, What was the progress of revegetation of deglaciated terrane during the retreat, especially during temporary advances, What subsequent shifts in vegetation have there been in postglacial time, Contrasts as well as similarities with northwest European vegetational history are apparent and provide valuable insights into climatic history and biogeography. Several of the usual procedures of pollen analysis have been modified. Mostly late and post-Wisconsin vegetational history in central and eastern United States are considered, with main emphasis on results of several recent studies representing some of the new approaches. Sixteen pollen diagrams are included. — ESL

Wright, James C. *See* Finch, Warren I. 08707

01756 **Wrigley, Robert C.** Some cosmogenic radionuclides in the Lost City meteorite: Jour. Geophys. Research, v. 76, no. 17, p. 4124-4126, table, 1971.

Nondestructive, two-parameter analysis of γ rays from a 435-gram fragment of a slice of the Lost City meteorite yielded concentrations for the cosmic-ray-produced radionuclides Na-22, Al-26, Mn-54, and Co-60. The concentrations are Na-22, 84 ± 3 dpm/kg; Al-26, 56 ± 6 dpm/kg; and Mn-54, 76 ± 4 dpm/kg. The Co-60 concentration shows anomalous behavior but is, in any case, low and indicates a small (<27 cm) preatmospheric radius for Lost City. The Al-26 concentration indicates a cosmic-ray-exposure age longer than several half-lives of Al-26. The Na-22/Al-26 ratio confirms an earlier explanation by Fireman (1967) of the seeming lack of solar-cycle control of this ratio. — Author's abstract

01740 **Wu, Tien Hsing.** Soil dynamics: Boston, Mass., Allyn and Bacon, Inc., 272 p., illus., tables, 1971.

This book presents the fundamentals of soil dynamics and related problems of design. Stress-strain relationships, elasticity, and plasticity of soils are discussed and also wave propagation and the effects of loading and various types of vibration. Earthquake-induced ground vibration and deformation of structures is covered as well as design of structures to prevent or modify such deformation. — EH

Yancey, T. *See* Wilde, P. 01993

01868 **Yatsimirskiy, K. B.; Yemel'yanov, Ye. M.; Pavlova, V. K.; Savichenko, Ya. S.** Determination of microquantities of nickel and cobalt in small weighed portions of marine suspended matter (from the Baltic Sea and Atlantic Ocean): Oceanology, v. 10, no. 6, p. 901-905, tables, 1970 [1971].

Kinetic methods were used to determine microquantities of nickel and cobalt in small weighed portions of marine suspended matter (1 to 3 mg) collected on biological filters with pores 0.7 μ in diameter (60 samples). The catalytic reaction to iron - diphenylcarbazone - hydrogen peroxide was selected and analyzed for quantitative determination of nickel. The quantitative determination of cobalt was based on the oxidation of alizarin by hydrogen peroxide at pH 12.4. The sensitivity of the reaction was 1×10^{-3} μ g per liter for nickel and 5×10^{-3} μ g per liter for cobalt. The relative error in determining cobalt and nickel was ±20 percent and ± (27-53 percent), respectively. Suspended matter from the Atlantic Ocean basin (0-1-m layer) contained from 2×10^{-4} to 3.8×10^{-1} μ g per liter of nickel and from 7×10^{-5} to 1.9×10^{-2} μ g per liter of cobalt, amounting as percentages of dry weight to 2×10^{-5} to 1×10^{-2} of nickel and 2×10^{-6} to 7.1×10^{-3} of cobalt. — Authors' abstract

Yemel'yanov, Ye. M. *See* Yatsimirskiy, K. B. 01868

01595 **Yochelson, Ellis L.** Phylum and class nomenclature in systematics: Systematic Zoology, v. 20, no. 2, p. 245-249, 1971.

Yochelson discusses the changing concepts of taxa above the family level and the confusion arising from lack of uniformity in nomenclatural endings for orders, classes, and phyla. The International Code of Zoological Nomenclature does not have formal rules for names above the family level. Problems have arisen when authors do not give a diagnosis of a new taxon and are vague about the level to which a high-level taxon is assigned. The "Treatise on invertebrate paleontology" has been evolving a style for treatment of suprageneric names (Teichert, 1965). Examples of inconsistencies discussed here include the living worm order/class or phylum Gnathostomulida (Riedl, 1969) and the fossil mollusk classes Monoplacophora (Knight and Yochelson, 1960), Stenothecoida (Yochelson, 1968, 1969), Hyolitha (Marek and Yochelson, 1964), and Mattheva (Yochelson, 1966). — VMJ

01605 **York, D.; Strangway, D. W.; Larson, E. E.** Preliminary study of a Tertiary magnetic transition in Colorado: Earth and Planetary Sci. Letters, v. 11, no. 4, p. 333-338, illus., tables, 1971.

Nine of 26 basaltic lava flows near State Bridge, central Colorado, possess directions of remanent magnetization intermediate between older normally magnetized flows and younger reversely magnetized flows. The intermediate directions vary only slightly from flow to flow, apparently indicating that this sequence came out in rapid succession. Paleointensity studies indicate paleofields of approximately 0.5 Oe and 0.65 Oe during eruption of the oldest normal flows and youngest reverse flows, respectively. Intermediately magnetized flows generally indicate low field intensities with a minimum of 0.04 Oe. Indications are that the field collapsed rather than flipped over during the reversal. We conclude from whole-rock K-Ar dating on 12 of the lavas that the lower normally magnetized section and the lavas in the transition are approximately 24.0 m.y. old, whereas the upper reversely magnetized section is 21.5 ± 1.0 m.y. old. — *from* Authors' abstract

York, Derek. *See* Watkins, Norman D. 01470

01452 **Yorke, Thomas H.; Davis, William J.** Effects of urbanization on sediment transport in Bel Pre Creek basin, Maryland, *in* Geological Survey Research 1971, Chap. B: U.S. Geol. Survey Prof. Paper 750-B, p. B218-B223, illus., tables, 1971.

The effect of urban expansion on sediment yield of a 1.7-sq-mi drainage basin is described. Streamflow and sediment data were collected at a gaging station on Bel Pre Creek in Montgomery County, Md., between 1963 and 1967. Prior to March 1965, the drainage area was used for pasture and woodland; however, between March 1965 and August 1967, part of the basin was developed for garden apartments and townhouses. A graphical regression analysis indicated that the storm runoff increased 30 percent, and the sediment yield was 14 times greater as a result of urban construction on about 15 percent of the drainage basin. Sediment yield from construction sites was 90 times greater than that expected under original land-use conditions. — *from* Authors' abstract

Youmans, Arthur H. *See* Guy, James O. 02040

Young, Myron H. *See* Sonu, Choule J. 01960

Yunker, J. D. *See* Schmidt, A. W. 02042

01615 **Zack, Allen L.** Ground-water pumpage and related effects, southwestern Louisiana, 1970, with a section on surface-water withdrawals: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 27, 33 p., illus., tables, 1971.

Ground-water withdrawals for rice irrigation in southwestern Louisiana are inversely related to total rainfall during the growing season. This relation can be used to estimate ground-water pumpage if precipitation figures are known. Continually increasing pumpage from Chicot aquifer has caused levels to decline steadily, which necessitates frequent lowering of pump intakes in the Lake Charles area and locally in Evangeline Parrish. A map showing average annual rate of water-level decline in southwestern Louisiana can be used to approximate future water levels at any location, highlights critical areas of high pumpage and low transmissivity, and delineates

recharge boundaries of Chicot aquifer. Heavy ground-water withdrawals in the Lake Charles area have caused salt-water encroachment in the aquifer. In parishes along Atchafalaya River, salt-water monitor wells indicate decreasing amounts of chloride in ground water probably due to induced recharge from the river — *from* Author's abstract

02031 **Zanier, Aldo M.; Pert, Donald M.** The salinity log — A tool to determine reservoir producing properties, *in* SPWLA Logging Symposium, 12th Ann., Dallas, Texas, 1971, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. K1-K11, illus., tables, 1971.

In most fields it is difficult to determine reservoir producing properties using conventional logs and interpretation techniques. By making a field study of formation water salinities it is possible to determine and predict initial producing performances of a well. Techniques are shown which will eliminate errors caused by using uncorrected absolute values of salinity computed from logs. Charts relating salinity variations and producing characteristics of wells are made for each field. Construction of stabilized potential contour maps, using salinity data, can aid in field development and reduce completion and drilling costs. — DBV

Zeid, Marvin C. *See* Overton, Harold L. 02077

01710 **Zen, E-an.** Comments on the thermodynamic constants and hydrothermal stability relations of anthophyllite: Am. Jour. Sci., v. 270, no. 2, p. 136-150, illus., tables, 1971.

Using Greenwood's (1963) experimentally bracketed p,T point for the reaction anthophyllite = 7 enstatite + quartz + steam, and thermodynamic data from several other studies, the standard Gibbs free energy of formation of anthophyllite from the elements at 25°C, 1 bar (G°_{A} (298,1)) is calculated to be -2716.3 ± 4 kcal, and the standard enthalpy of formation is -2888.1 kcal. These values imply an enthalpy change for the above reaction, in close agreement with a value of + 12 kcal calculated from Weeks' (1956) heat of formation data for anthophyllite, but drastically disagrees with two others. Greenwood's (1963) hydrothermal data for the reaction 4 forsterite + 9 talc = 5 anthophyllite + 4 steam yield a value of about -2720 kcal indicating good internal consistency of his experimental data. The stability of anthophyllite remains problematic. — *from* Author's abstract

08762 **Ziegler, A. M.; Boucot, A. J.** North American Silurian animal communities, *in* Correlation of the North American Silurian rocks: Geol. Soc. America Spec. Paper 102, p. 95-106, illus., 1970.

Distinctive marine benthonic assemblages, defined in Upper Llandovery rocks of the British Isles as *Lingula*, *Eocoelia*, *Pentamerus*, *Strickland*, and *Clorinda* Communities, represent as listed increasingly deeper water, each probably gradational with its neighbors. Interstratified volcanics and sediments provide clues to substantiate relative depth. In North America essentially in the same form, their distribution is shown on four Upper Llandovery time-interval maps, graptolite facies indicating deep-water conditions; extent downward and upward is shown on a Lower Llandovery map and a Ludlow-Pridoli map. Areal and stratigraphic distribution of shelly faunas and community relations are described for six time-intervals. Several Silurian shorelines in the Appalachian region are indicated. — GDC

01606 **Zwart, William J.** (editor). Index of wells shot for velocity: [Tulsa, Okla.] Soc. Exploration Geophysicists, 85 p., 1971.

In this eighth edition of the "Index of wells shot for velocity" wells are listed by state, county, township, range and section, except for Texas, where they are listed by county and then alphabetically by companies. — EH

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